



The Animate Button

Mocap Automation Techniques at
Ubisoft Montreal

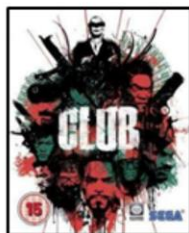
Dan Lowe

Senior Technical Animator – Ubisoft Montreal

GAME DEVELOPERS CONFERENCE March 14–18, 2016 · Expo: March 16–18, 2016 #GDC16



- So hi there, good afternoon and welcome to this talk, which is: "The Animate Button – Mocap Automation Techniques at Ubisoft Montreal".
- Who am I...



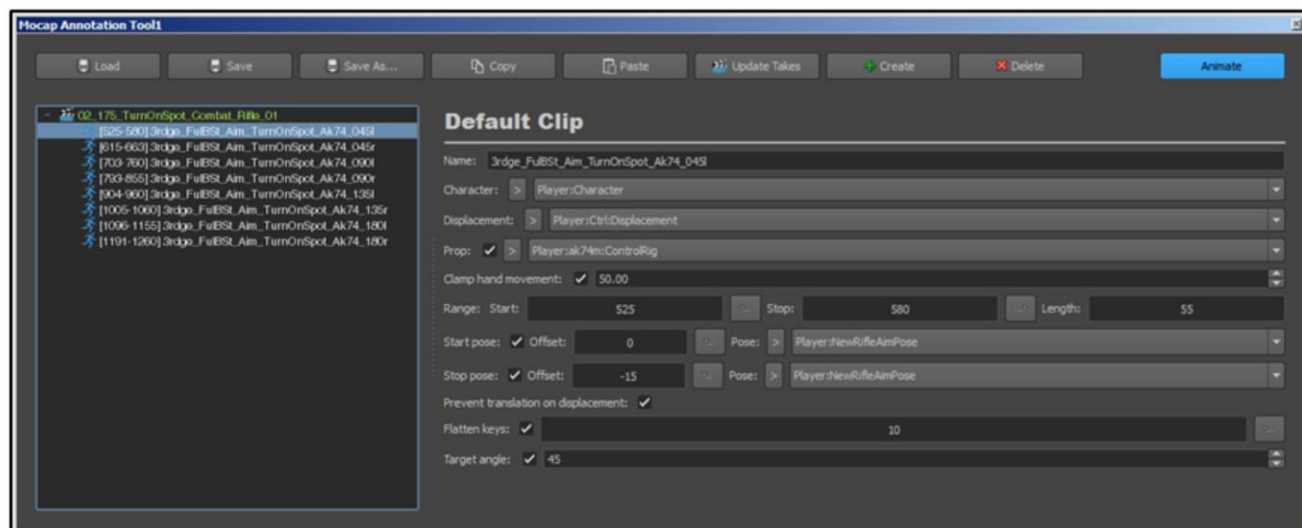
- I'm Dan Lowe... I'm a Senior Technical Animator at Ubi Montreal... I worked on a bunch of games... as you can see here.
- I know different companies have different definitions for a what a technical animator is: Basically I come from an animation background and most of my day is spent animating just like any other animator... but I also do a lot of technical things on the side like building state graphs, designing animation tools, working on the pipeline, making sure everyone's working in the best way, that kind of thing.
- And right now I'm working with Ubisoft's Technology Group... on Automation tools for animators... and this is what I'm going to be talking about today...
- Before I start, I want to give credit to this guy...



- ... this is Zach Hall, he's one of our Animation TDs at Ubisoft... and everything I'm going to talk about today is stuff that I worked on together with Zach.



- So why, "The Animate Button"?
- If you're not familiar with this... here's this short video that I found on the internet, that might explain it... [PLAY: Video shows an animator pushing an "Animate Button", and the computer animates the character for him]
- So yeah, it's this a common joke I think most animators know... where it's like... hey, we animate on computers... we should just push the "Animate" button... and let the computer do everything...
- And of course this is ridiculous, because we know what really goes into it, but the premise of this talk is to look at this question... "With mocap at least... Why not?" We've already made a lot of our creative decisions on the mocap stage, so why can't the computer do at least some of these tasks for us.
- So I'll save you the suspense and tell you that we've totally built what is essentially an animate button... we have a tool that will take raw mocap data, and with a few basic inputs will automatically process that into shippable game animations.



- This is it, it's called the Automator... and if you look very carefully in the top right corner, maybe you can see the blue button says "Animate" on it... so this is just a tease for now, I'm going to be demoing this at the end of the talk.
- Before that, I'm going to go talk about all the steps we had to go through, to get to this point...

Talk Overview

- So this talk is split into 3 different parts.

Talk Overview

1. Mocap for automation

- First, automating mocap clean-up is much more difficult when you have bad mocap data to start with, so I'm going to cover some quick Ubisoft tips about how we get high quality mocap data.

Talk Overview

1. Mocap for automation
2. Adjustment blending

- Second, I'm going to talk about a new technique that we came up with which we're calling "Adjustment Blending", and that's really at the core of what makes all of this automation stuff possible.

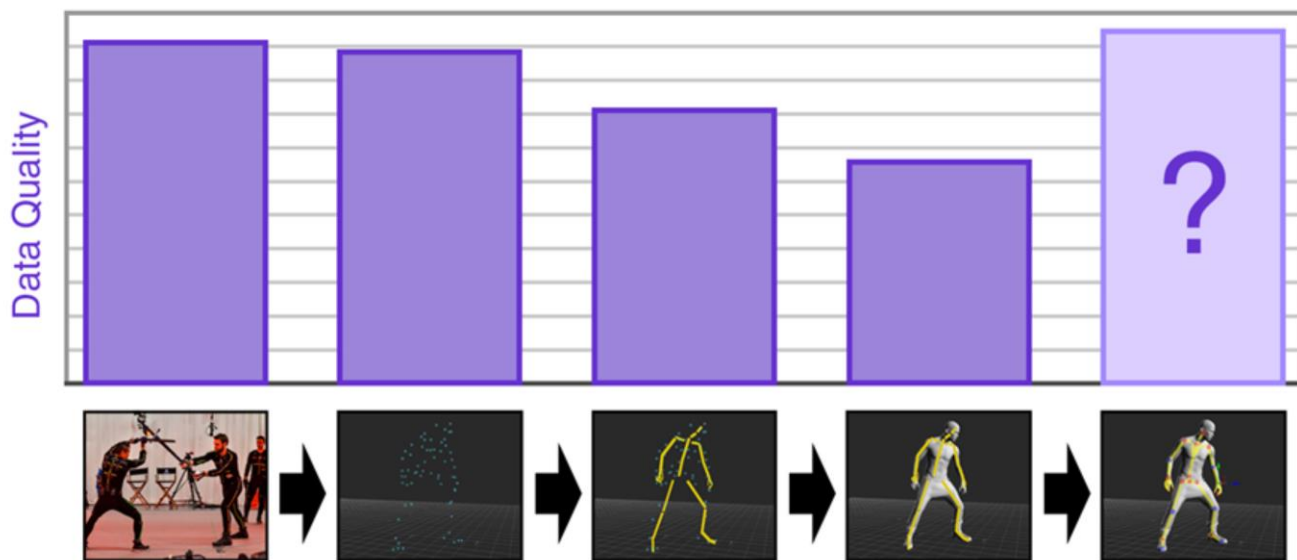
Talk Overview

1. Mocap for automation
2. Adjustment blending
3. Automation tools

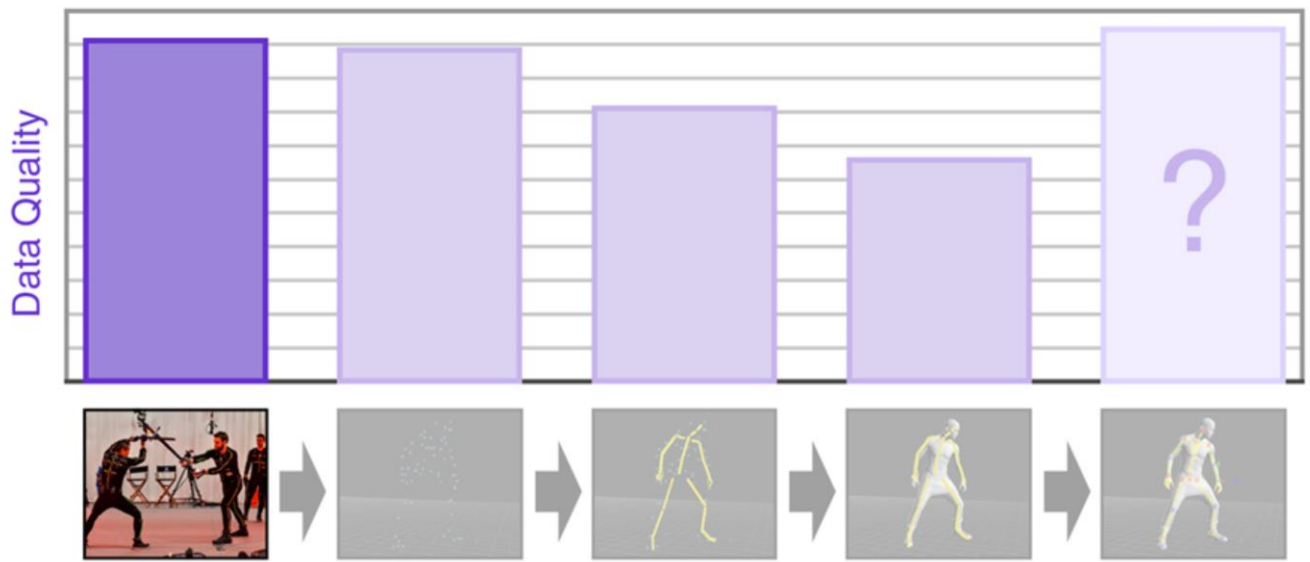
- And then last, I'm going to talk about the Automator tool, which is the tool that I just showed, and this is really where everything comes together.

MOCAP FOR AUTOMATION

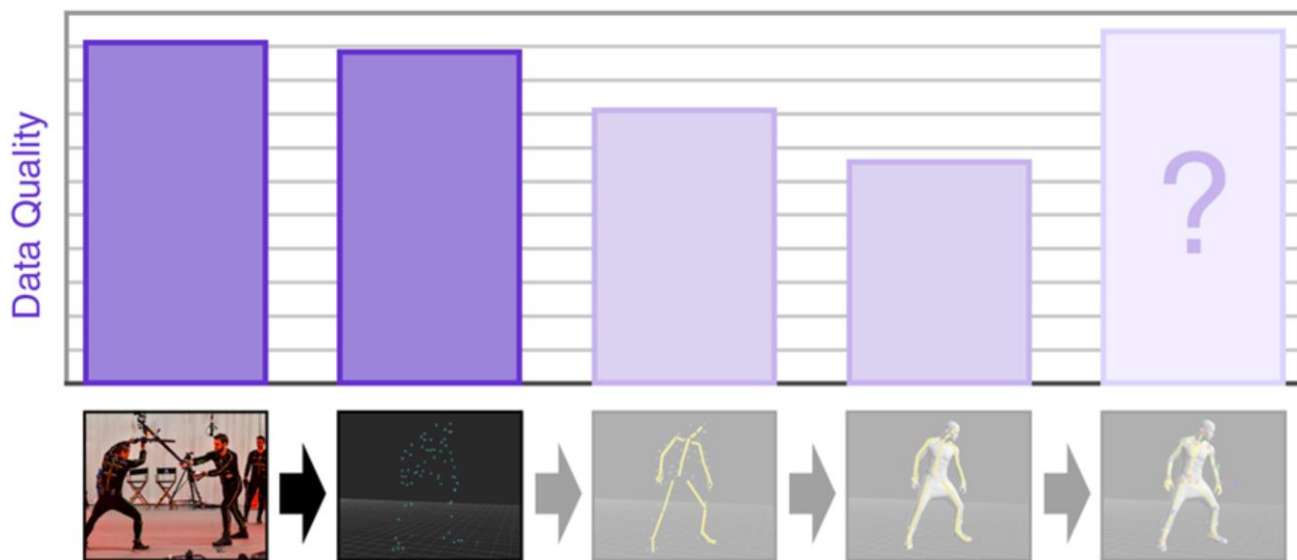
- So first, lets talk about mocap.



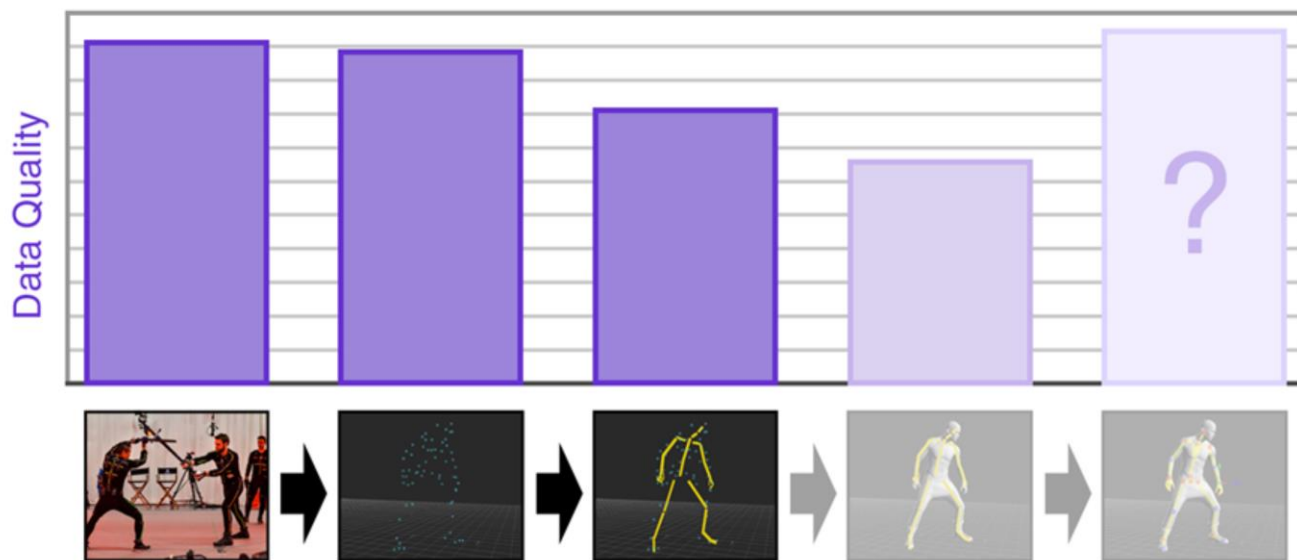
- So these bars here are meant to represent the quality level of our mocap data as it goes through a typical pipeline.
- And usually with mocap, you tend to lose a little bit of quality with every processing step... and then our animators try to add that quality back in with motion editing.



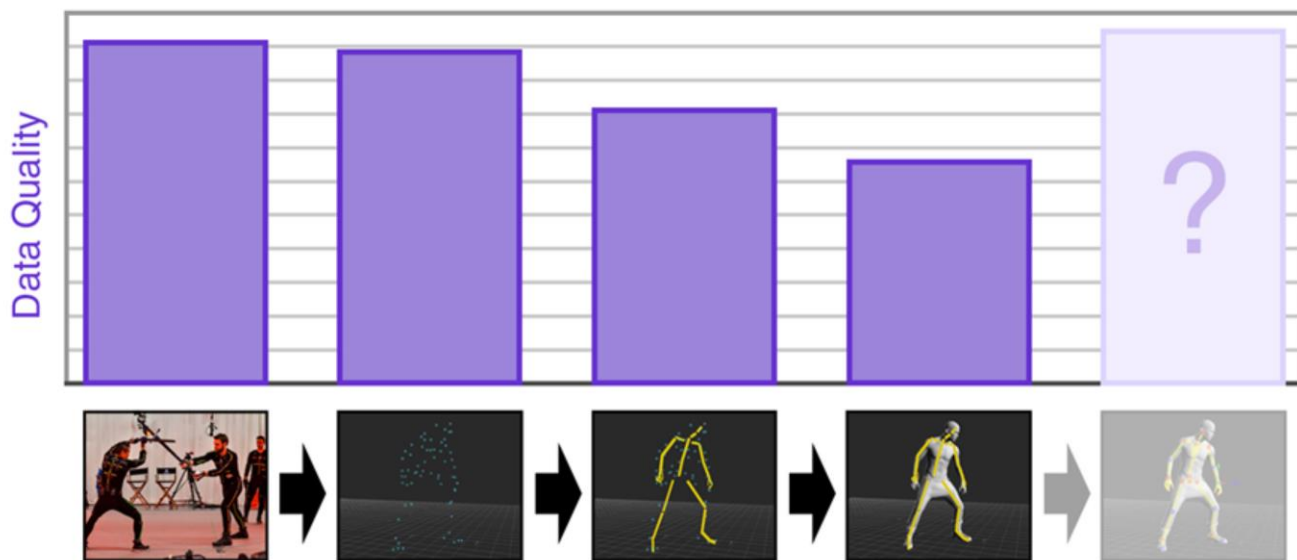
- So we start with our actors on the stage, and in terms of pure body mechanics this is essentially perfect, because we're dealing with a real person and we're dealing with real world physics.



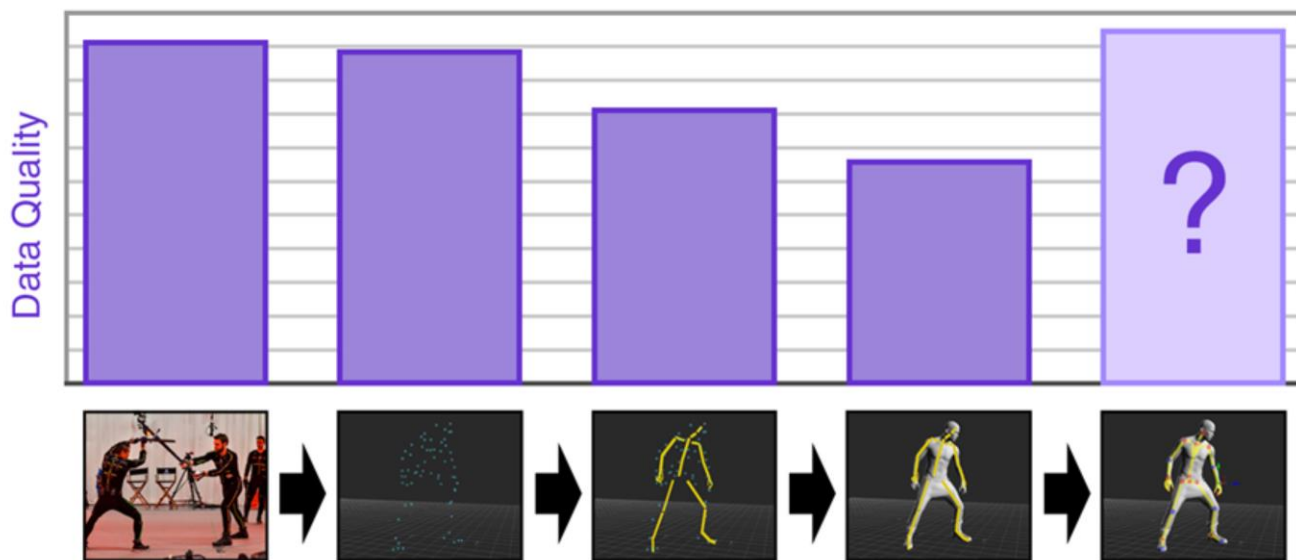
- Then the system turns that into marker data and we typically lose a tiny bit of quality here because occluded markers need to be reconstructed.
- I mean... technically we're losing a huge amount of information here... if we start thinking about muscles and skin, and that kind of thing... but in this case I'm just talking about optical mocap and reconstructing the optical markers.



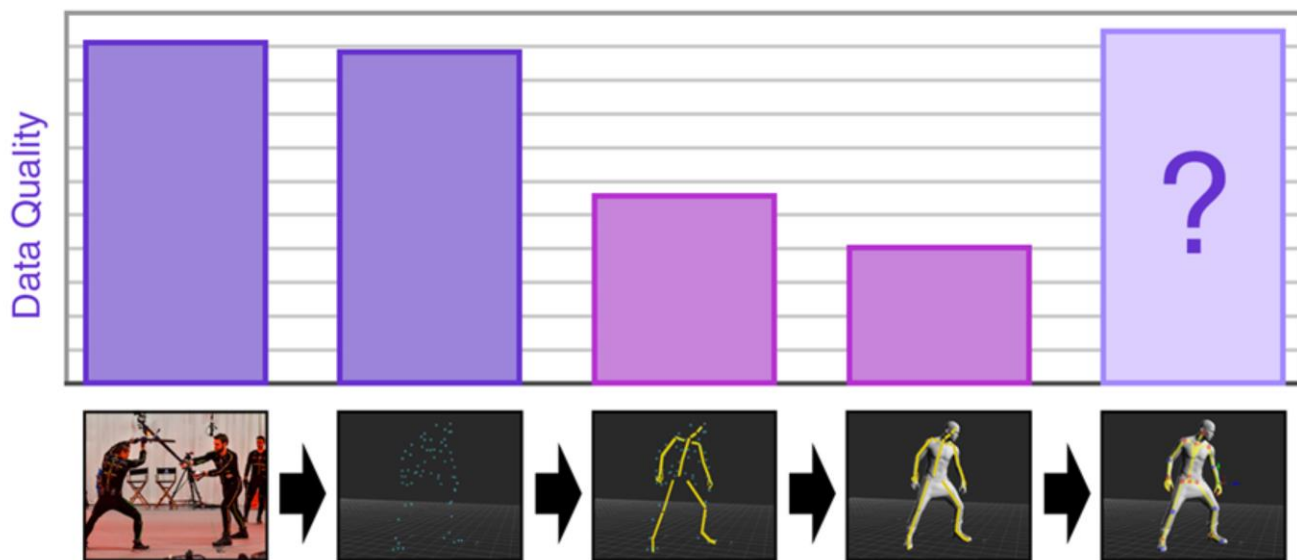
- Then we typically retarget from those markers to rigid bodies... and we lose some more quality there.



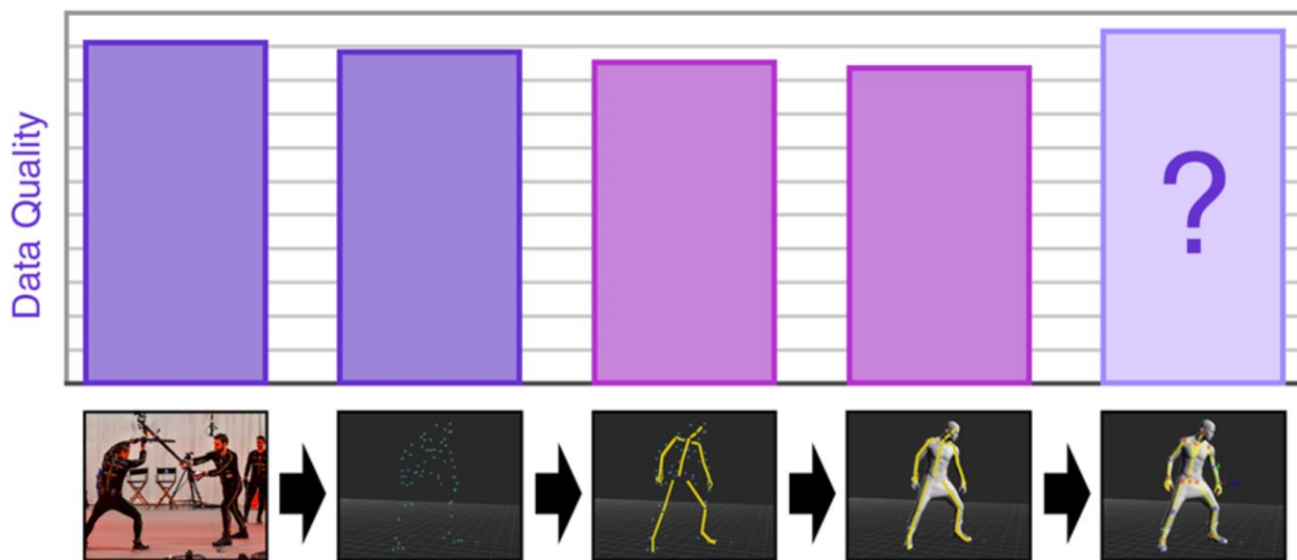
- Then we retarget *again*, from our rigid bodies to our game rig, and because of proportional differences between our mocap actor and our game character we can lose A LOT of quality here.



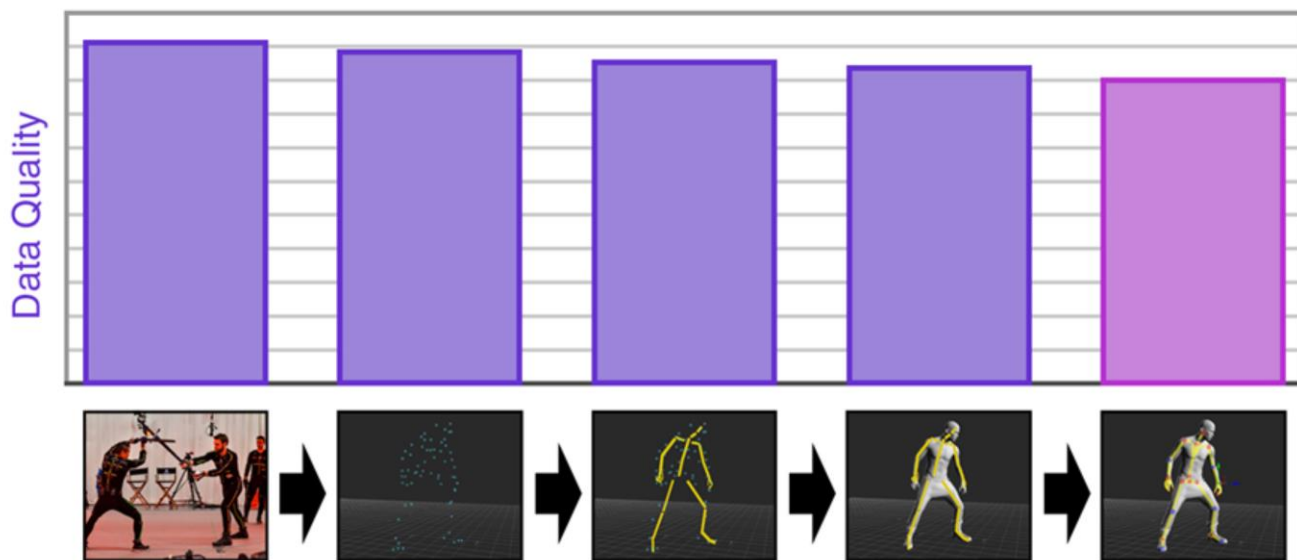
- And then we do our motion editing, and the reason I've put a big question mark here is that the quality you get here is entirely dependent on the ability of your animation team.
- We typically have to constrain the data in different ways, to work for our game systems, so often we lose some of the magic of that original data in that process.
- But on the other hand, this is where we can add stronger posing, we can exaggerate things and try and add more appeal, and so the quality can actually go up here.
- Now in a lot of pipelines, or with some individual animators, I see this...



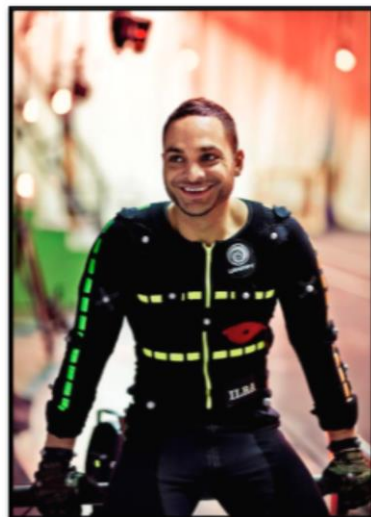
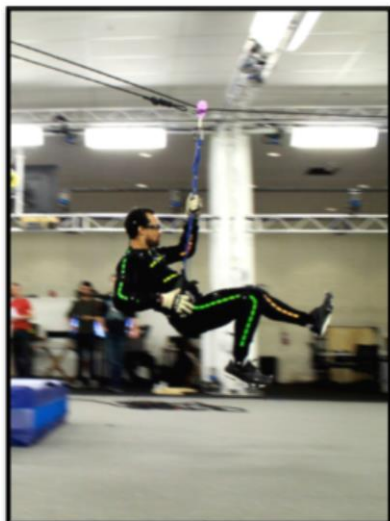
- ...where the animator does a very basic, low quality retarget, and then immediately bakes the data and starts animating, because they intend to fix all of their retargeting problems with animation at the motion editing stage.
- And I'd say that generally this is bad practice, because it's far more time consuming to fix things this way. If you fix a problem in the retarget, it's going to fix every instance of that problem throughout your entire mocap shoot, but if you do a bad retarget and then bake, you're going to have to fix all of those problems individually.
- With automation we really want things to look more like this...



- I mean really with any pipeline you want it to look like this... but it's especially important with automation, because...

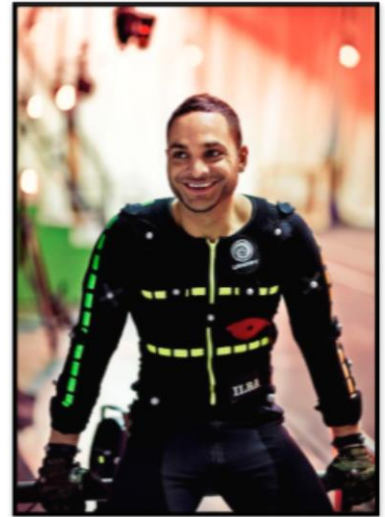


- ... it's very difficult to automate exaggeration and appeal... so it's very rare that quality at the editing stage will go up.
- Also, with every error that gets added through retargeting, if we're automating, we have to write some sort of script to clean that up, and so the fewer errors that we introduce in the first place, the easier our lives will be later.



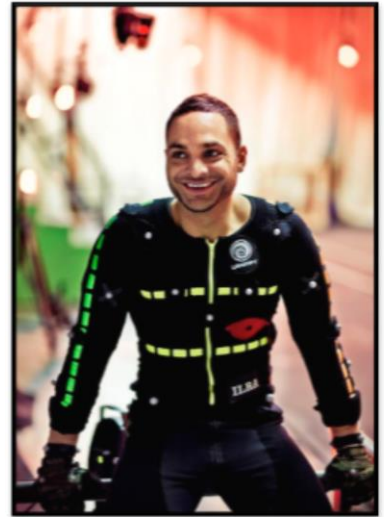
- So there's no one trick to this, it's really just a case of applying a lot of the lesson's we've learnt over time, and being very anal retentive about quality at each step.

- Hire professionals
- Plan and rehearse
- Capture face, body and voice at the same time
- Refine your marker setup



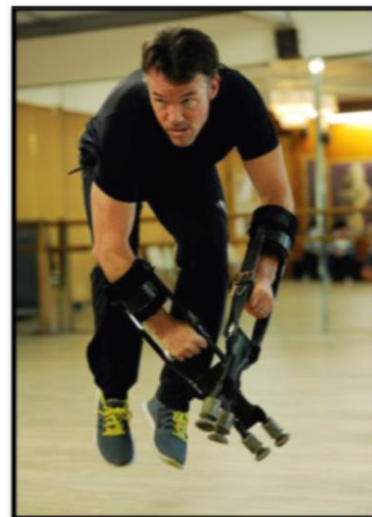
- So these are all points that I think... or would hope... that people are familiar with already... so I'm going to go through them really quickly... but I didn't want to talk about mocap quality without reiterating these points because they really are the most important things.

- Hire professionals
- Plan and rehearse
- Capture face, body and voice at the same time
- Refine your marker setup



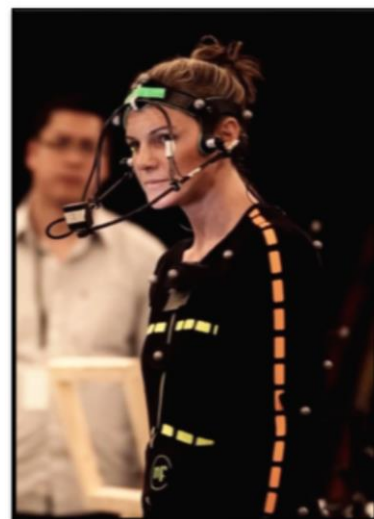
- So first, at Ubi we hire professional actors and stunt people for our shoots. This is probably the single most important thing you can do to get better quality mocap.

- Hire professionals
- Plan and rehearse
- Capture face, body and voice at the same time
- Refine your marker setup



- You should always plan your shoots way in advance. Shooting mocap is expensive so if you take time to plan and rehearse, you'll get through a lot more shots on the day.
- And as part of that rehearsal, we sometimes hire movement coaches. So this guy on the right here is Terry Notary, he's an movement coach that worked with us on Far Cry: Primal. You might be familiar with this guy; he was the movement coach on Planet of the Apes, The Hobbit, Avatar and a bunch of other movies.

- Hire professionals
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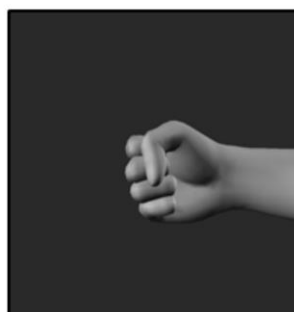


- We capture face, body and voice at the same time. Again, I think performance capture is something that's pretty well understood by now, at least for cinematics... but we're trying to do this more and more for gameplay as well.

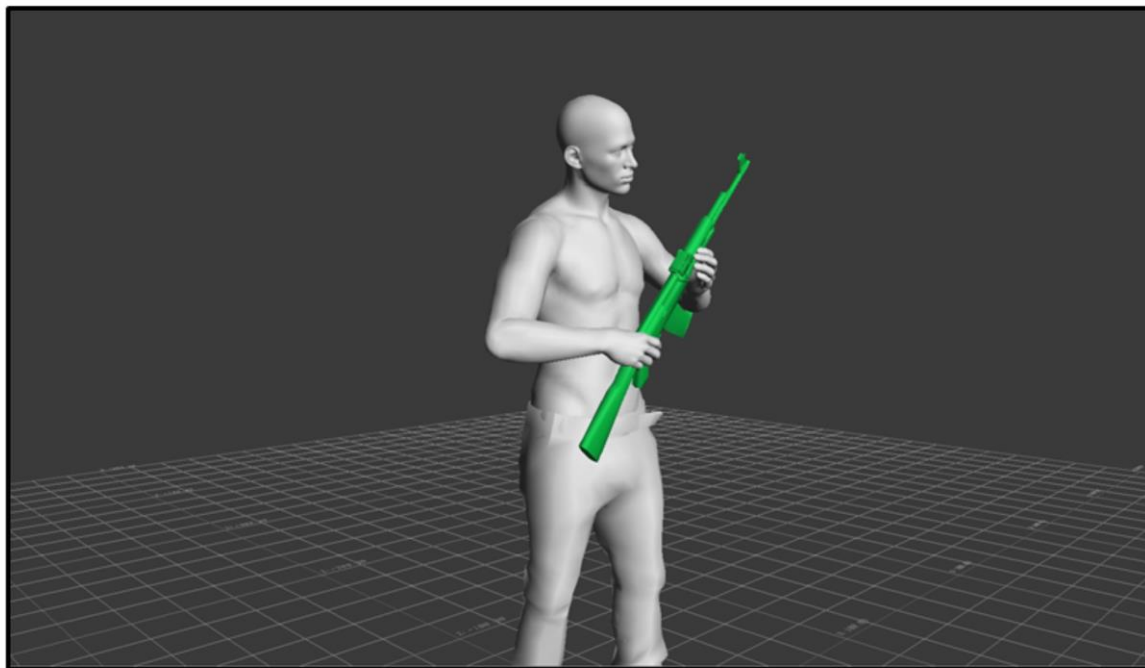
- Hire professionals
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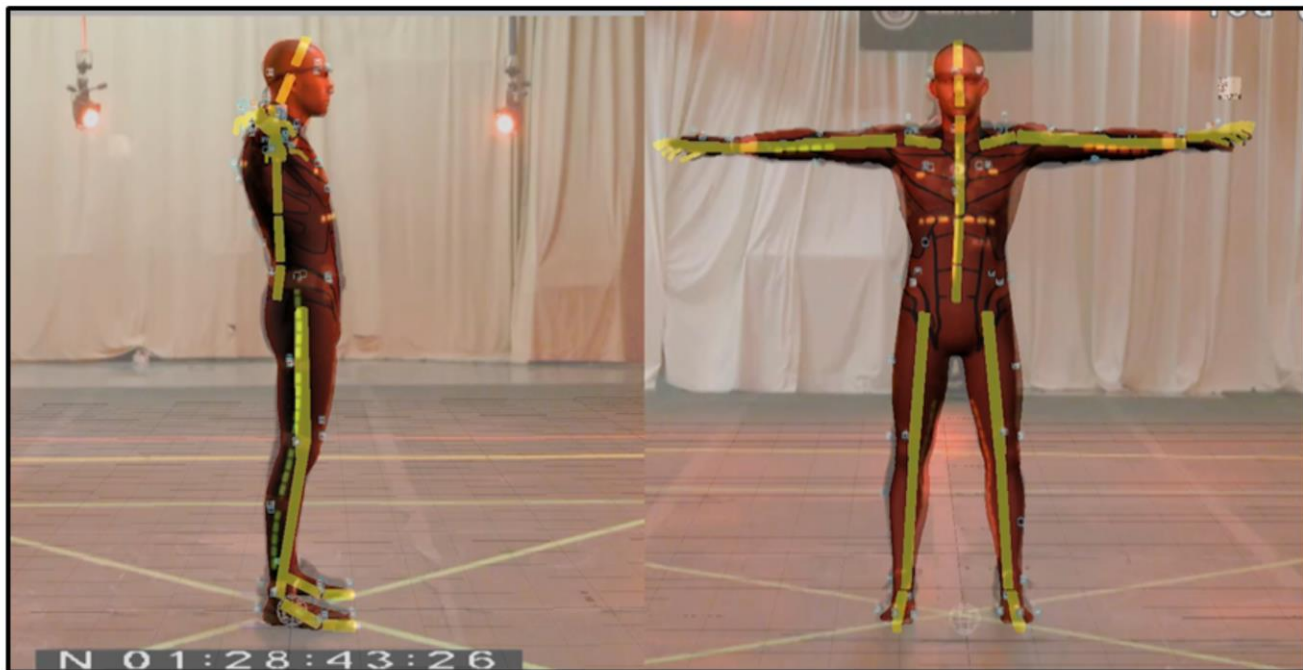
- And then refine your marker setup: Your marker setup makes a big difference to your retargeting result, so it's worth taking some time to try different setups and to make sure that your setup is optimal.



- One thing that we do that I don't think is quite as standard... is that we capture finger information at the same time as the body.
- What we do is an approximation, we're not doing *full* finger capture. We use two markers: One on the end of the the Index finger and one for the Pinky, which is what you can see in these two top images. Then we create these three, pre-set hand poses: One where the hand is fully open, one where it's relaxed, and then a fist, and then we use the mocap markers to drive those poses.



- And this actually works surprisingly well. What you see here in the video is just raw mocap, so all the finger motion here is what the hand pose system created.
- It's not perfect, but it's a pretty good base for us to work on.



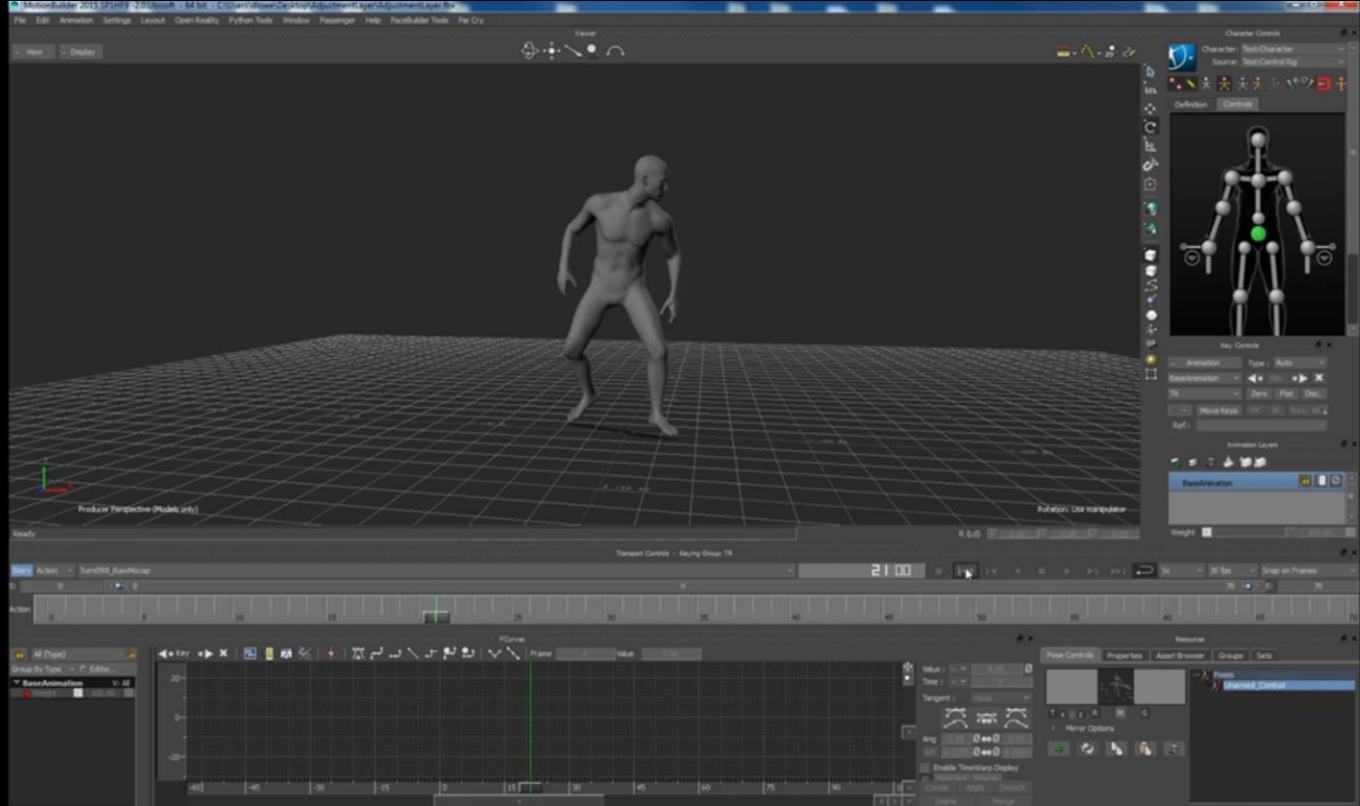
- So this is an interesting one: As I said before, one of the main reasons that problems get introduced with the retarget, is when there are proportional differences between the mocap actor and your game characters, so one of the things we're trying to do more and more of, is to try and build our character proportions to match a sort of averaged proportion set of our mocap actors.
- So the way I do this is I take the on set video from a range of motion take and then layer that over the retargeted character, and that makes it really easy to see when we have any problems, and then we iterate on the character proportions with the character team until we get something that we're happy with.
- There obviously still a few disparities here, but this is a proportion set that we came up with on Primal that's loosely based on some work that the Watch_Dogs team had done, as I say, we're pretty happy with it, and this has made a huge difference to the quality of our retargeted data.
- So with all of these mocap tips combined, the mocap data that we get is very high quality, and this immediately reduces a lot of the tasks that a mocap animator, or in our case an automation system, would have to do. And the just to reiterate, this it really critical to getting shippable quality data .
- But once we have this data, we now have to treat it, and that brings us to...

ADJUSTMENT BLENDING

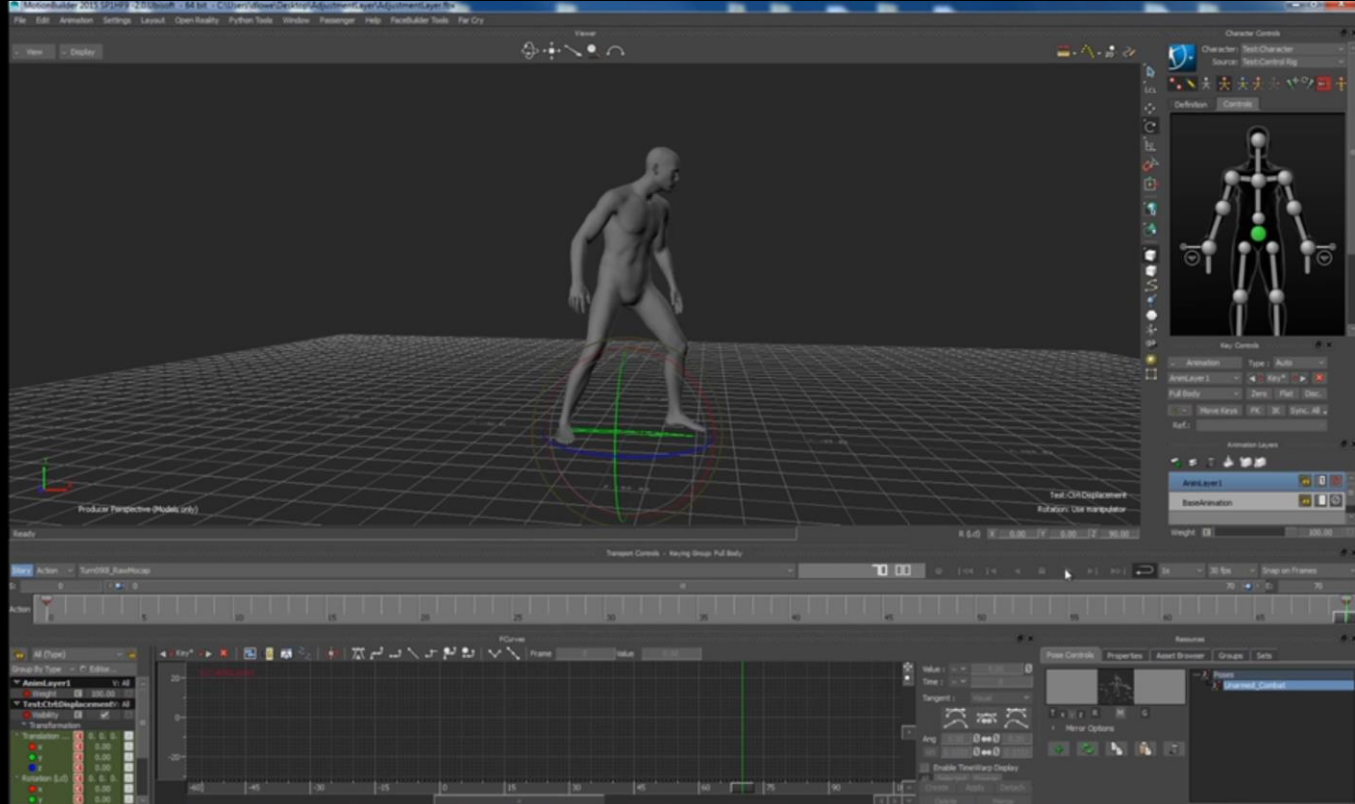
- ...Adjustment Blending.
- So I'm super happy that I'm finally able to show this off because I've been sitting on this a while and it's pretty awesome.
- So let's get to it...what is Adjustment Blending?



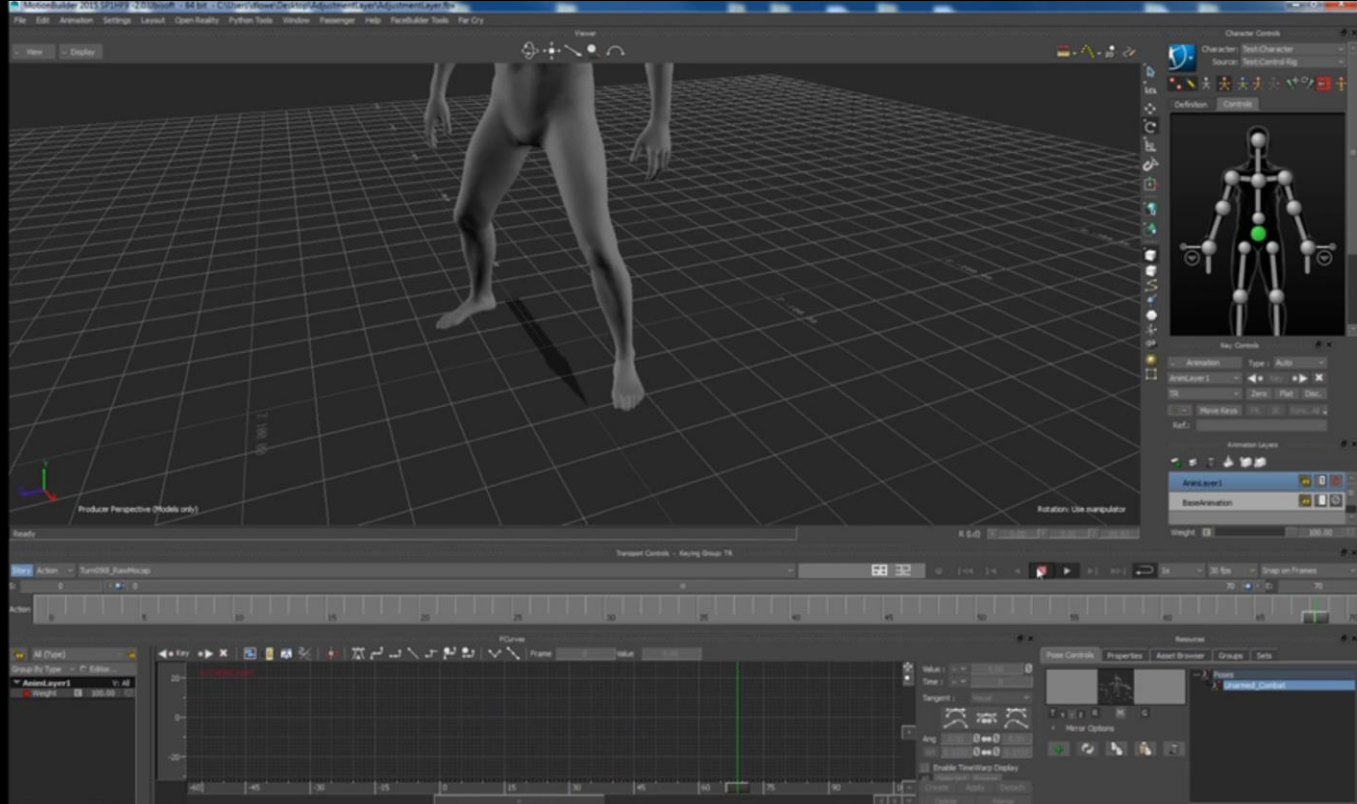
- So here we've got some raw mocap of a character turning on the spot, and this is the typical type of thing that an animator would need to clean up in their day to day work.



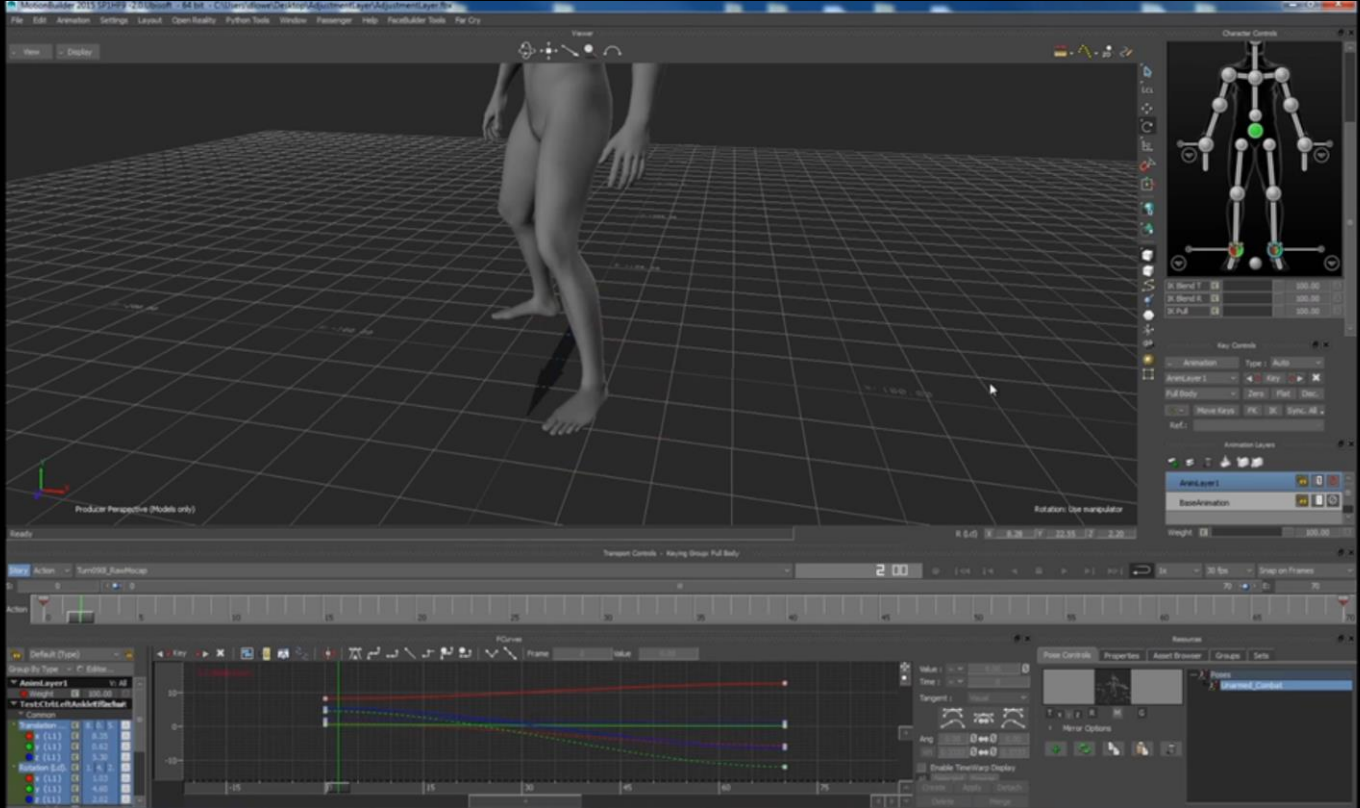
- And the way we'd do this, is first we'd create a layer... then apply our consistent pose... to... the start of the clip...and to the end...



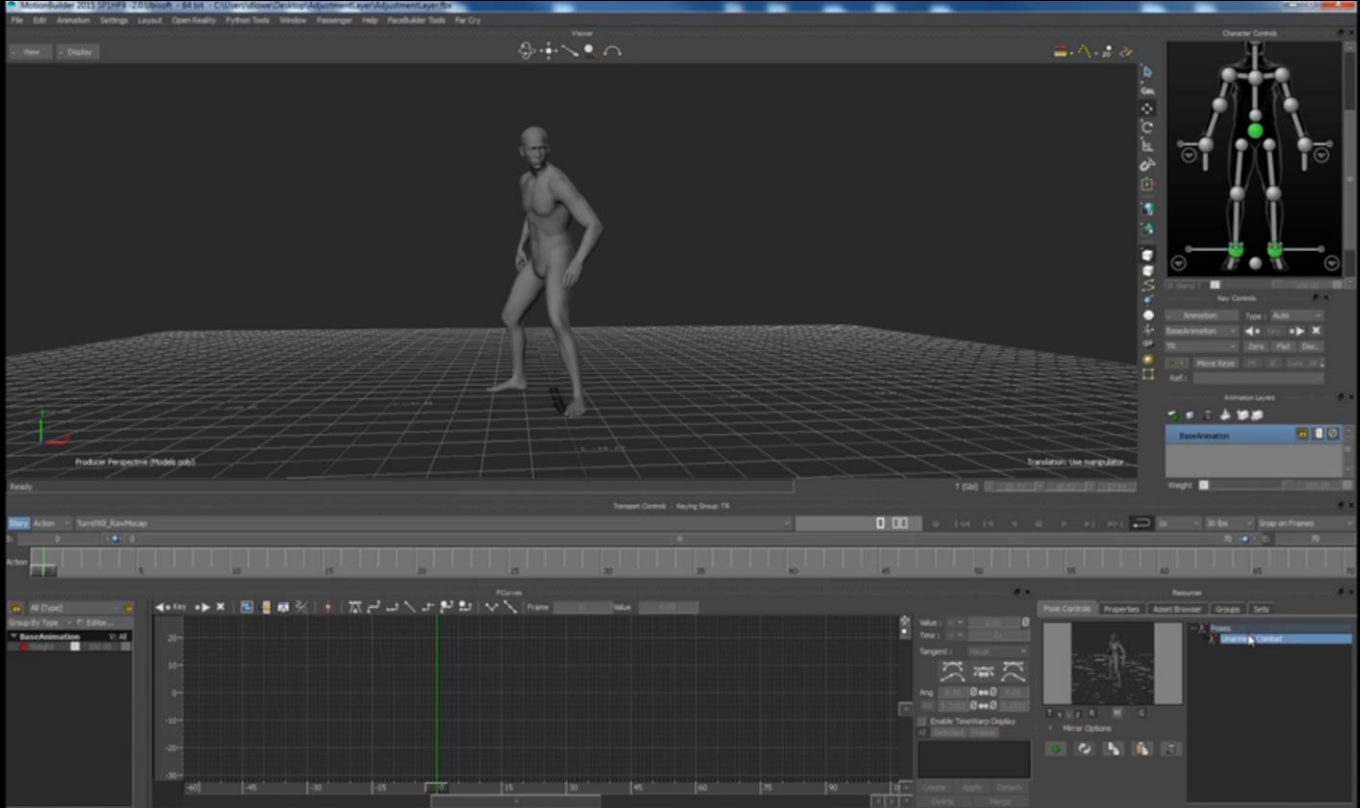
- But you'll notice however... that we now have sliding feet...



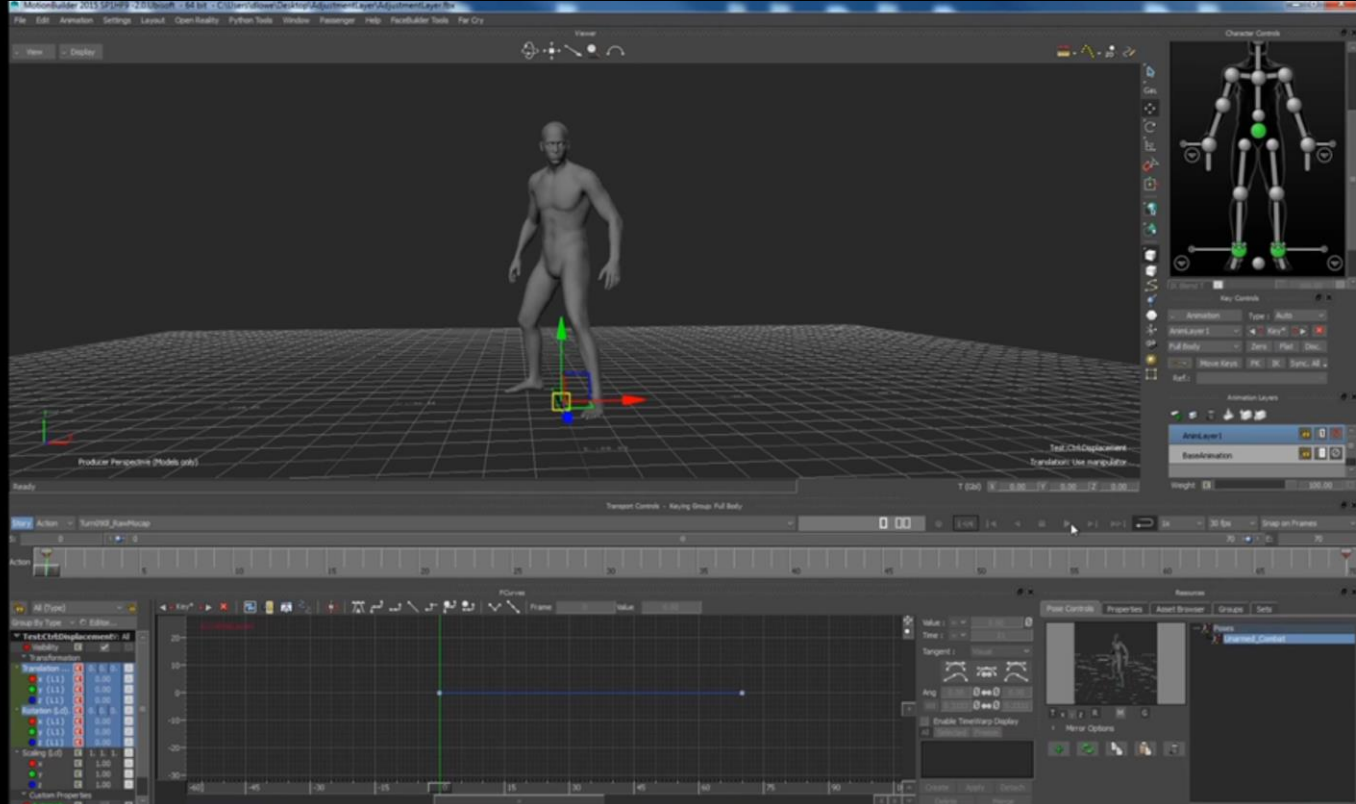
- And this is because... as you see here in the curves window...our pose change is being applied across the entire length of the animation.



- ...and so to fix this, and animator would have to manually adjust the curves, so that our pose change, only applies when the foot is moving. And this type of manually adjustment is really painstaking work, because it has to be done for each effector that's sliding, and although this is a simple example, in other cases there might be multiple footsteps that need to be compensated for.



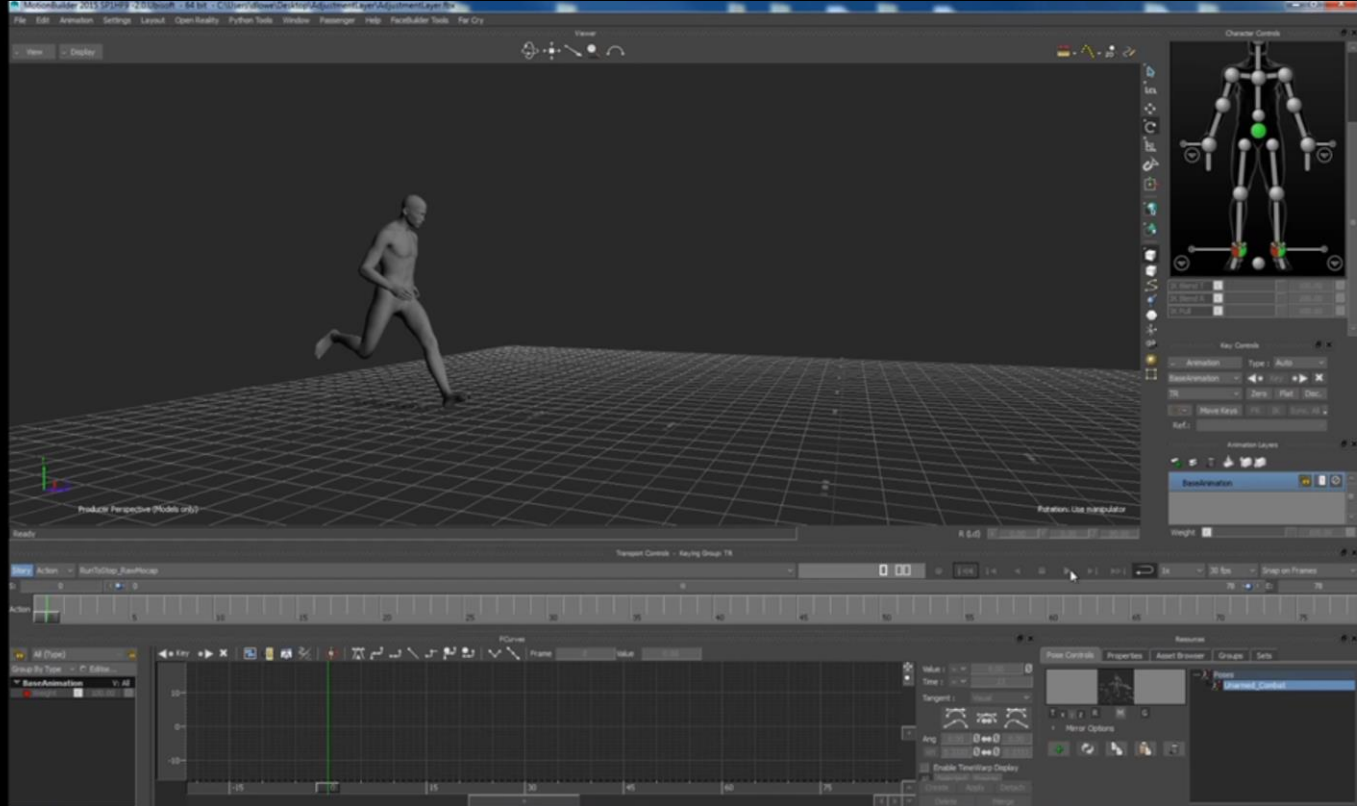
- So now lets look at the Adjustment Blending tool. And as before... we'll create a layer... and we'll apply our start pose... and our end pose...



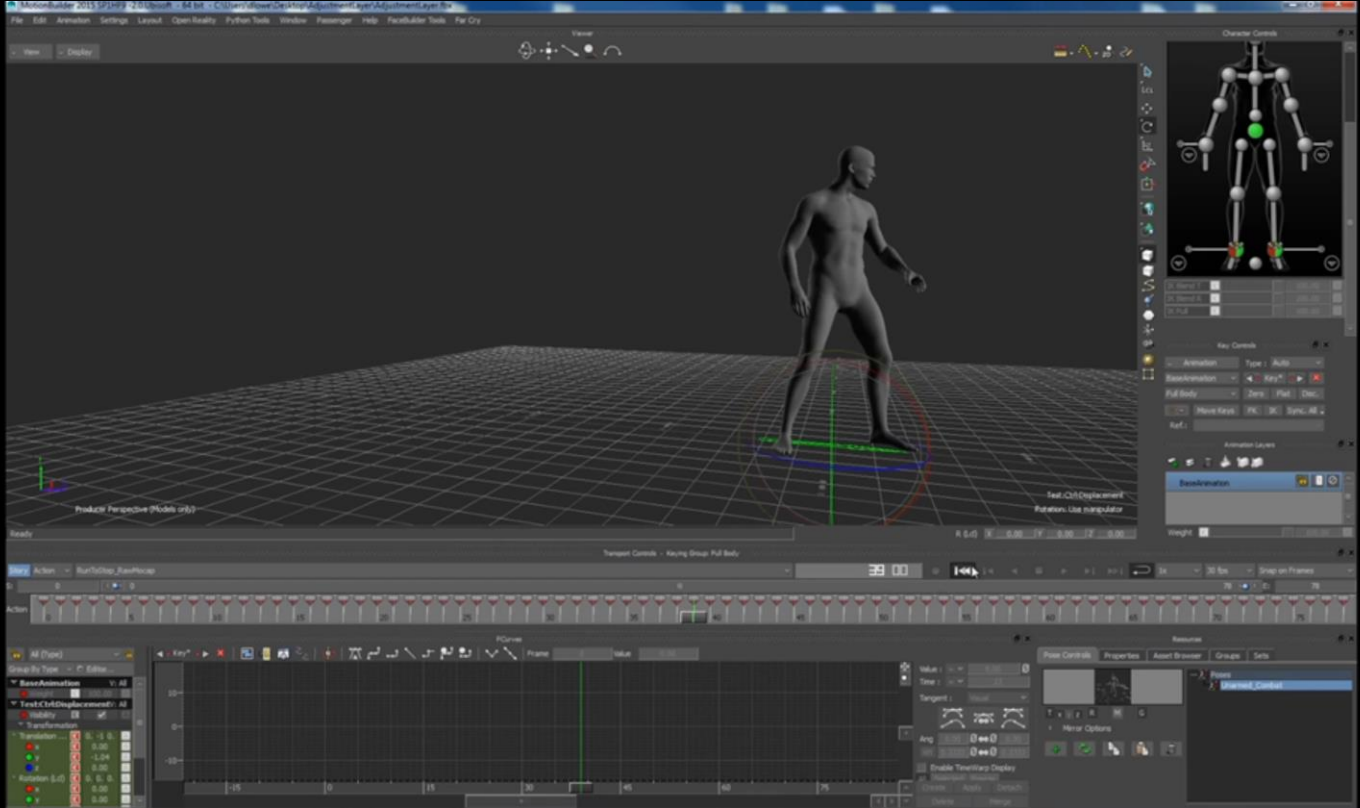
- ...and as before, we've got sliding feet...



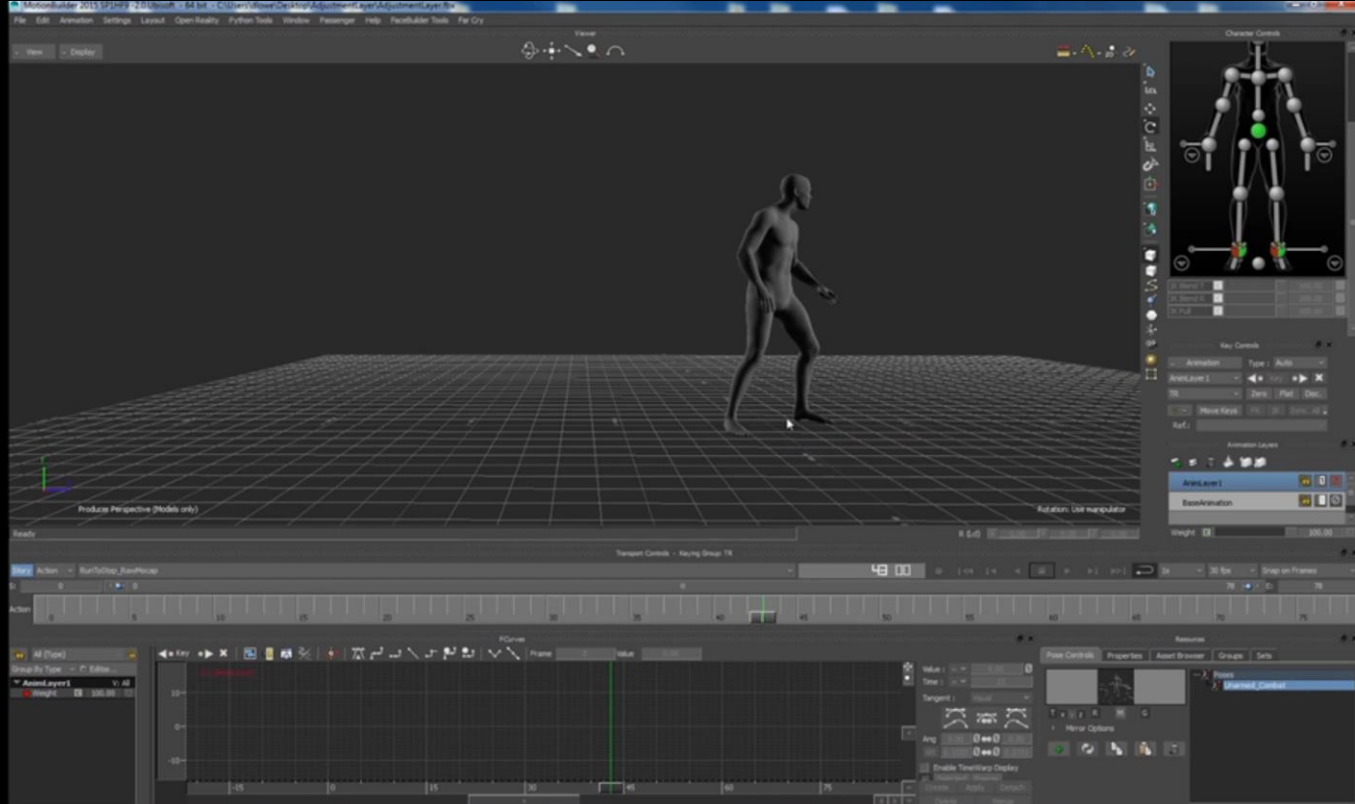
- ...and then we run the tool... and that's it, it's done... and you'll see now, that our feet are automatically fixed.



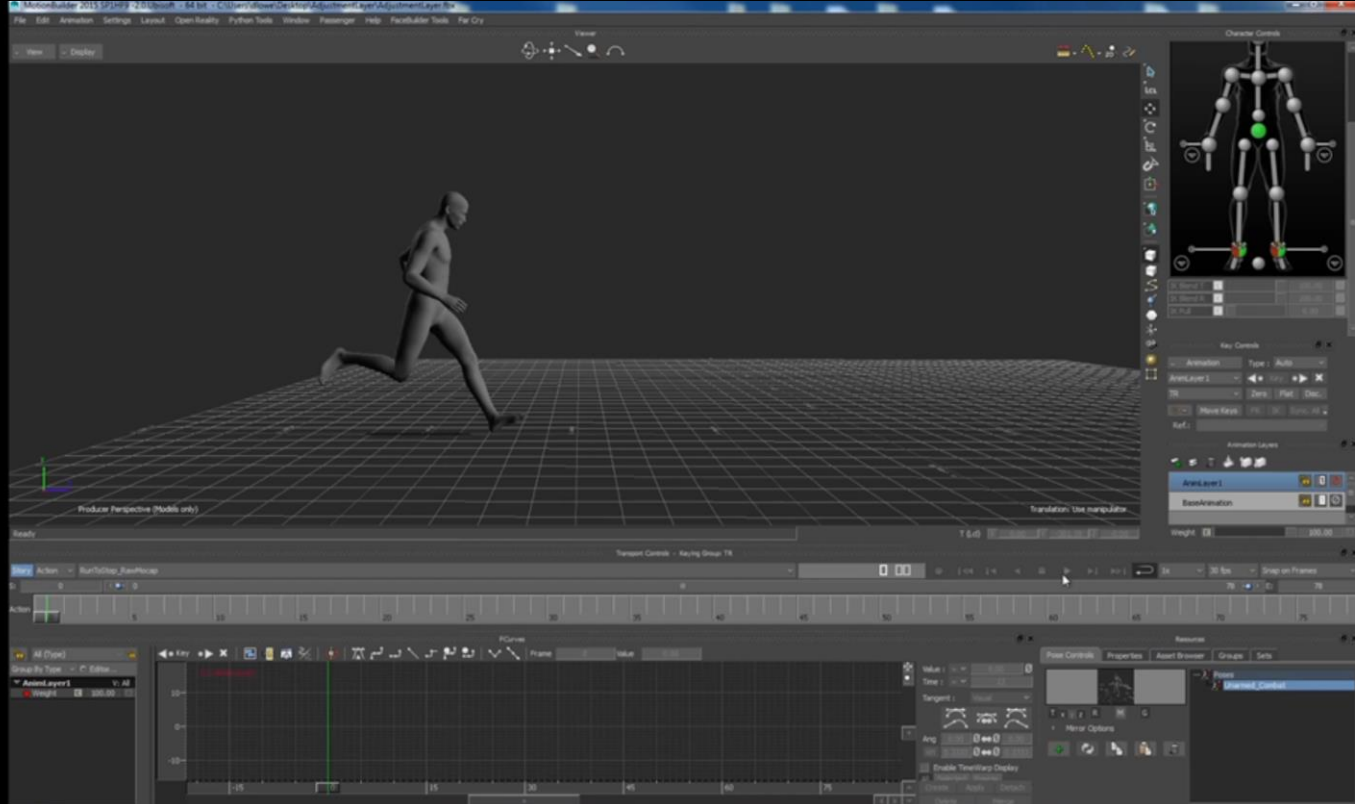
- So here's another example... we've got a character running to a stop...



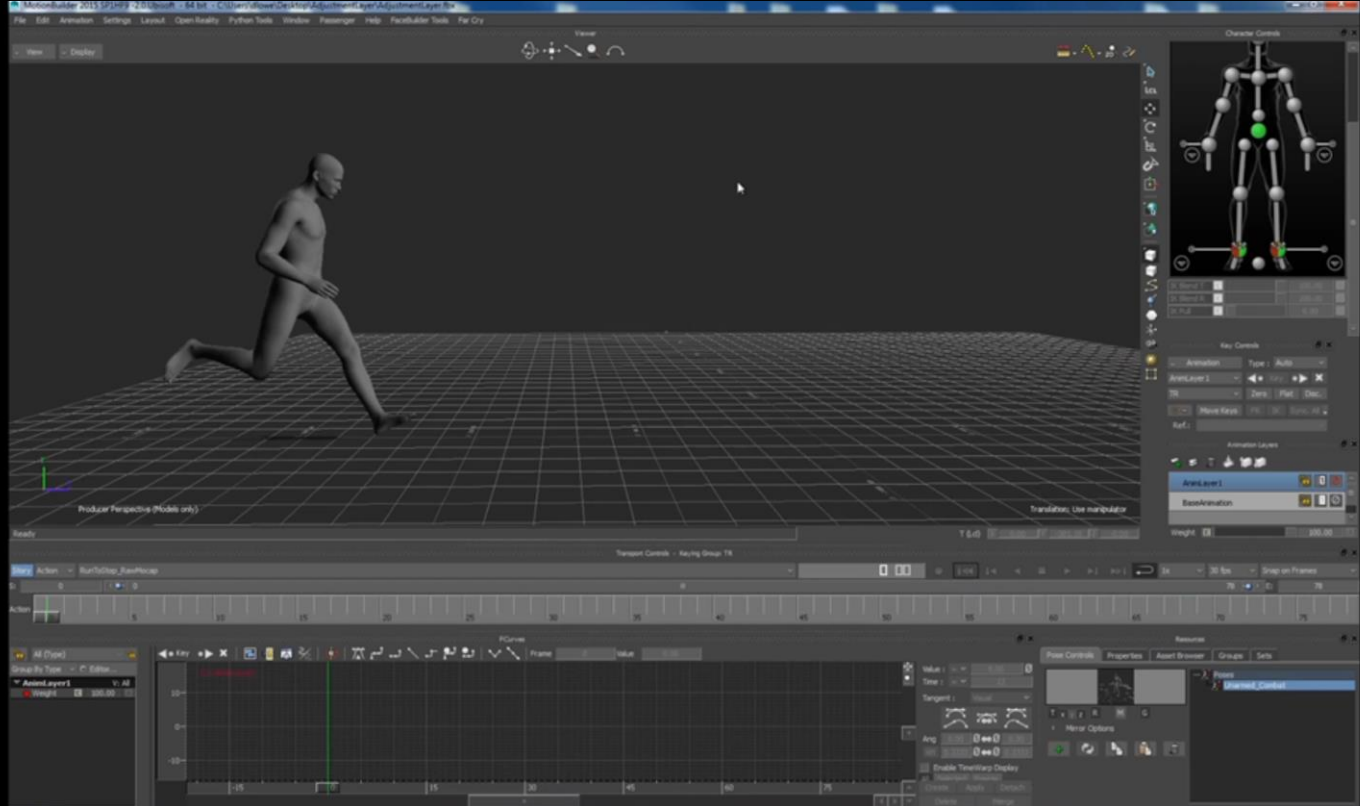
- ...and so first of all, we'll apply a zero pose to the start of our animation, so that we keep our run pose as it is...and we'll apply our consistent pose to the end of the animation...



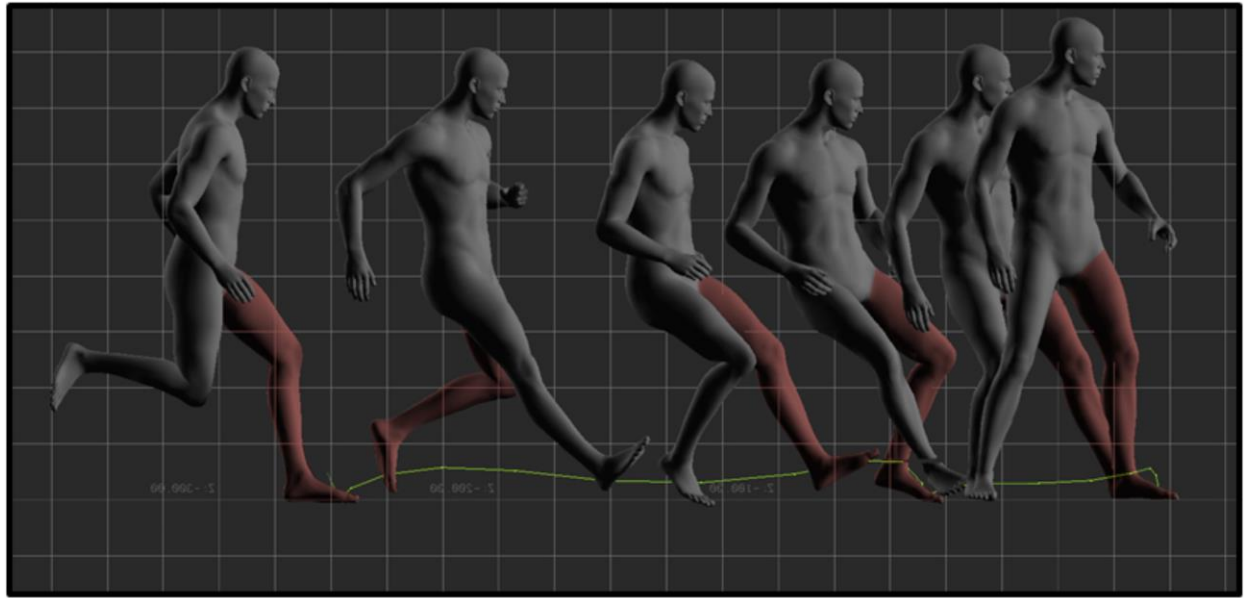
- ...but lets say that our game engine wants our stop distance to be a fixed length, say... 3 meters... so we'll slide our start pose to the correct length, and key it.



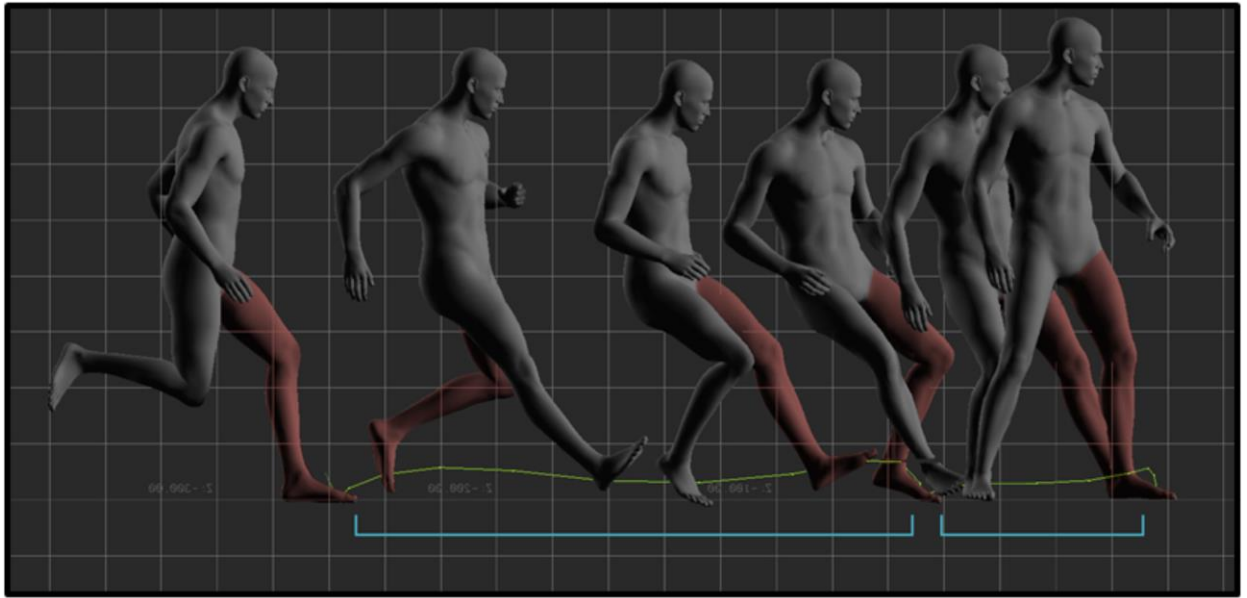
- ... and as before you can see we've got a lot of sliding... you notice that the hips are sliding at the end here where the character would normally settle... it's not just the feet.



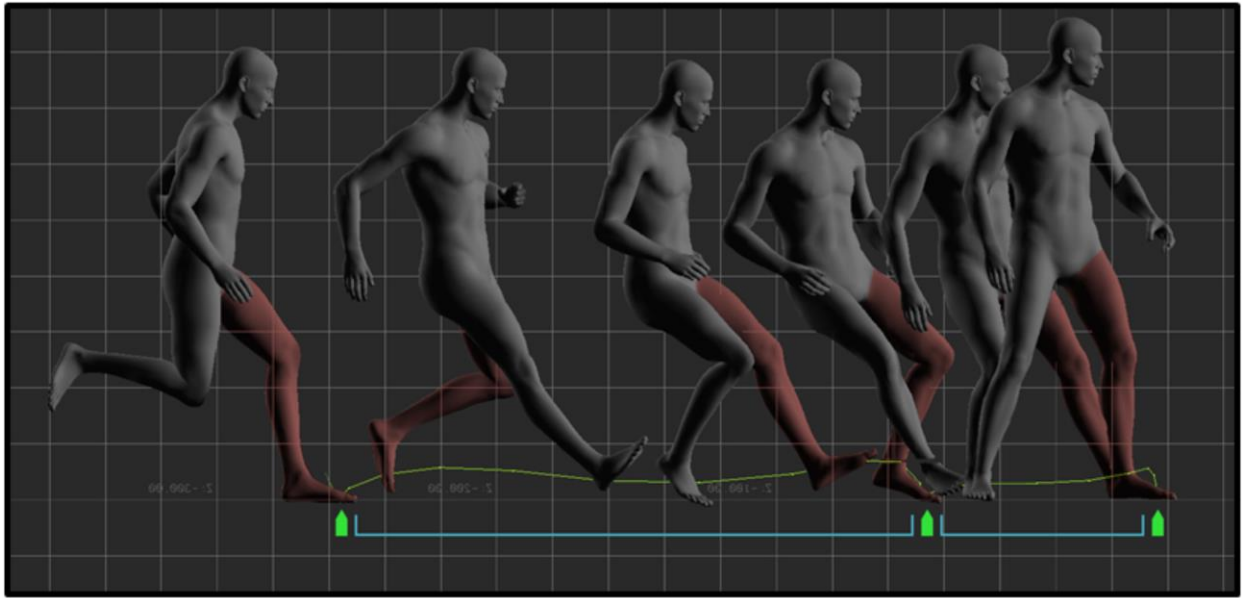
- So now we run the tool...and there we go... it's fixed all of our sliding problems and we have a nice grounded stop animation.



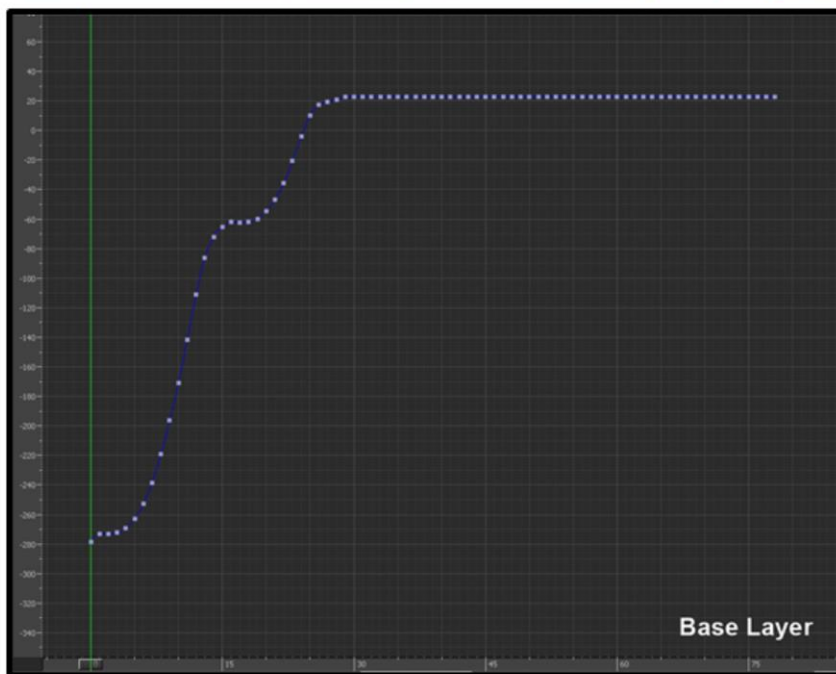
- So what are we actually doing here? [PAUSE]
- We want to hide any adjustments that we make... during the parts where our animation is already moving...



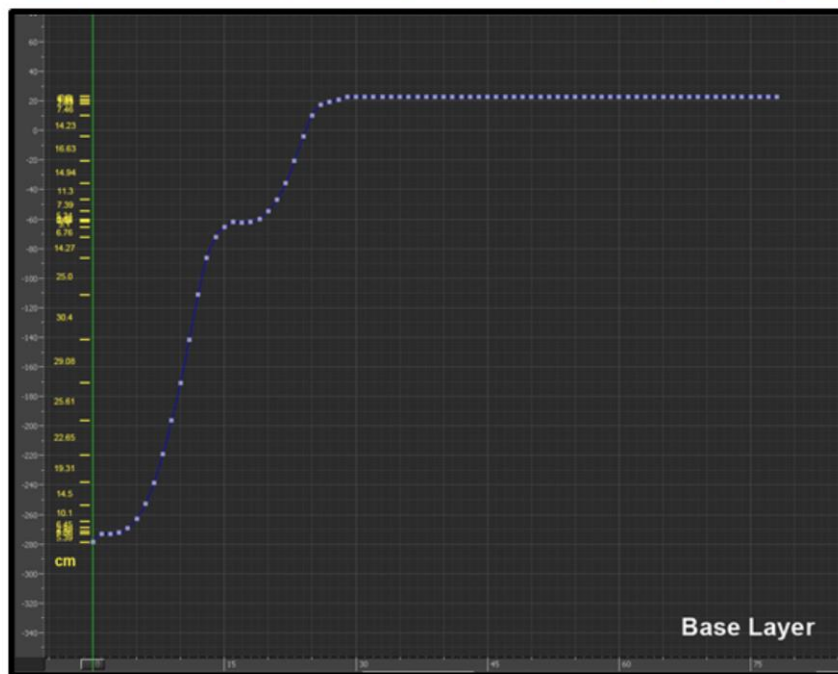
- ... And we want to make no adjustments...where our animation is still...



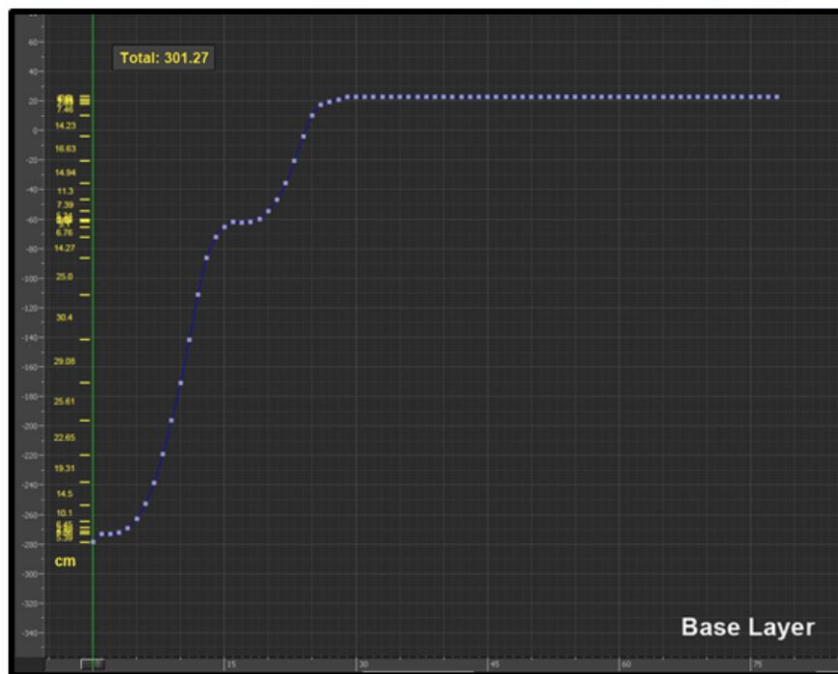
- ... so for example, when a foot's planted.



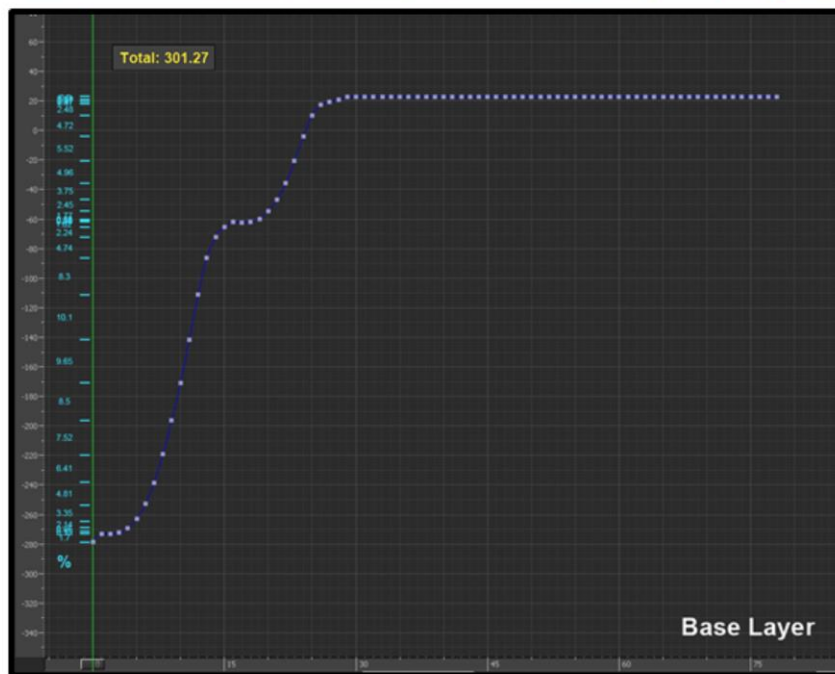
- So I'm gonna quickly dig into some math here... I know the talks for the bootcamp are animator focused, but this is actually pretty simple... and I want people to actually be able to implement this themselves at their own studios.
- Don't worry if you don't follow this perfectly... I'm going to post this method online, so if you just follow me on Twitter or something... and I'll post a link at some point.
- So, I said before, we want to find out where our character is already moving...
- So for each curve in the base layer of our animation... we start by looking at the amount of change that's happening from one frame to the next...



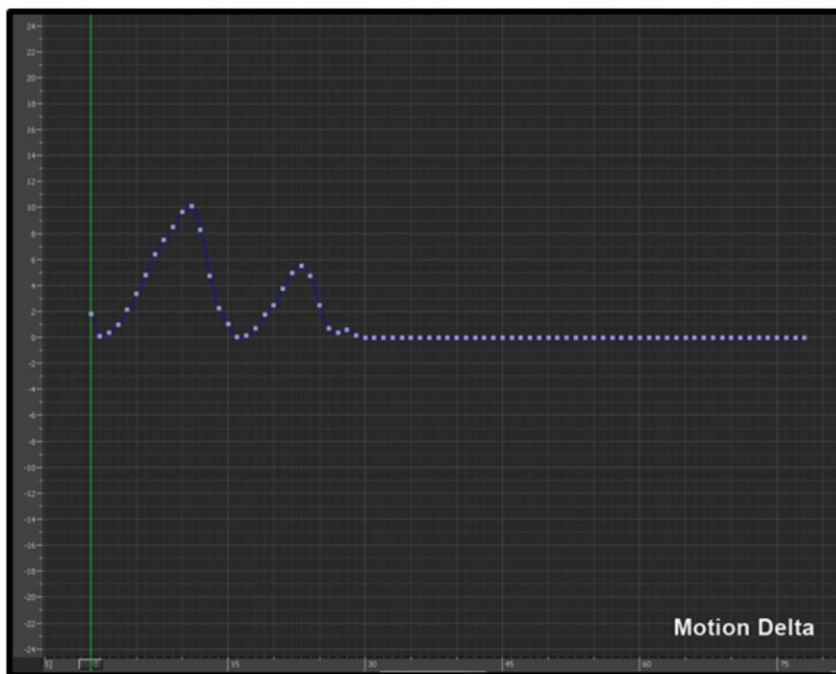
- ... and then we store those values... and total them up...



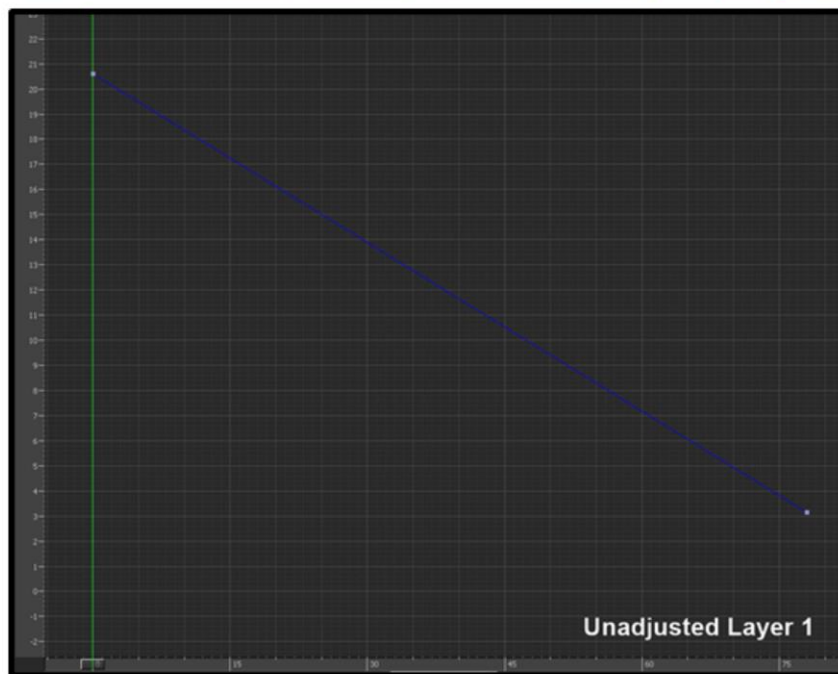
- ... We then convert these per-frame values into percentages of the total...



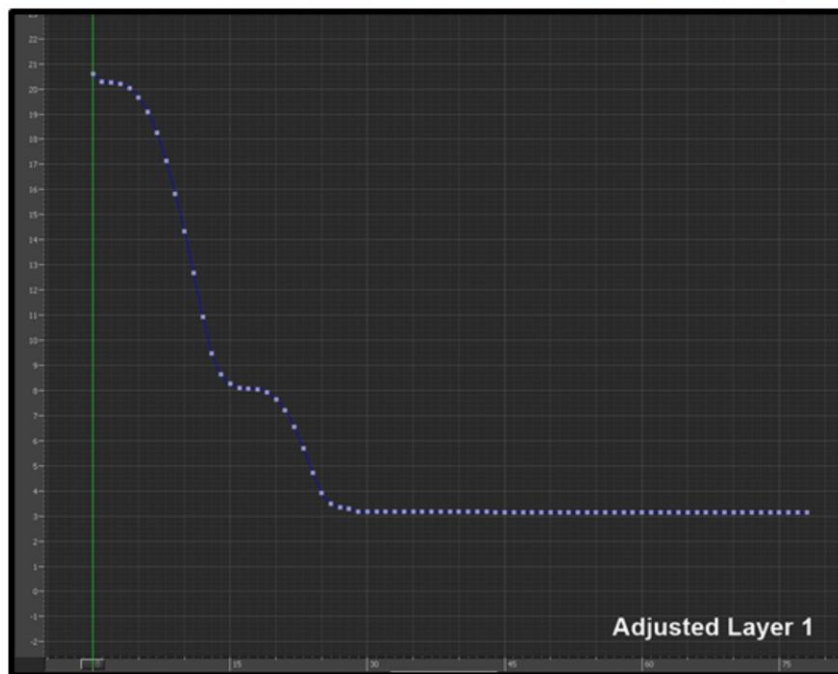
- Once we have that... if we then map these percentages to a curve you get something that looks like this...



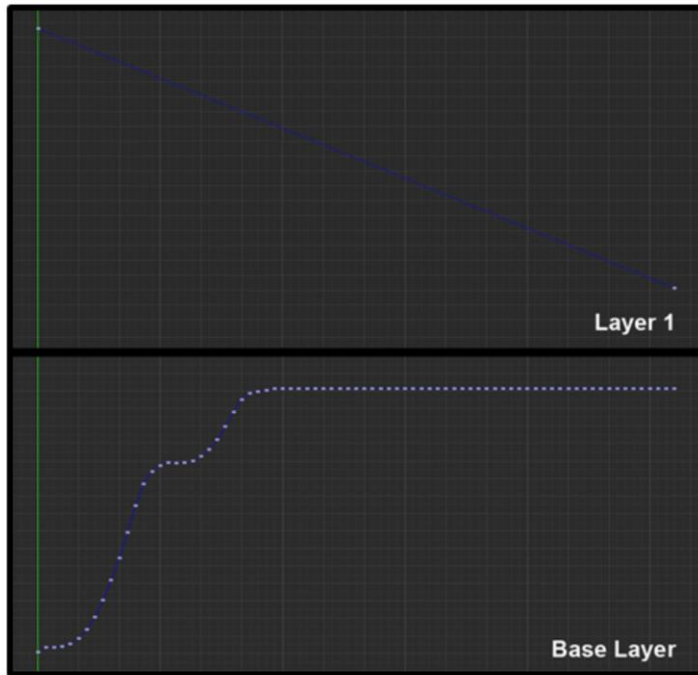
- ...So this is our motion delta. And as we wanted, it's showing us where we have movement and how much movement we have. The peaks here are movement, and the flat parts are static.



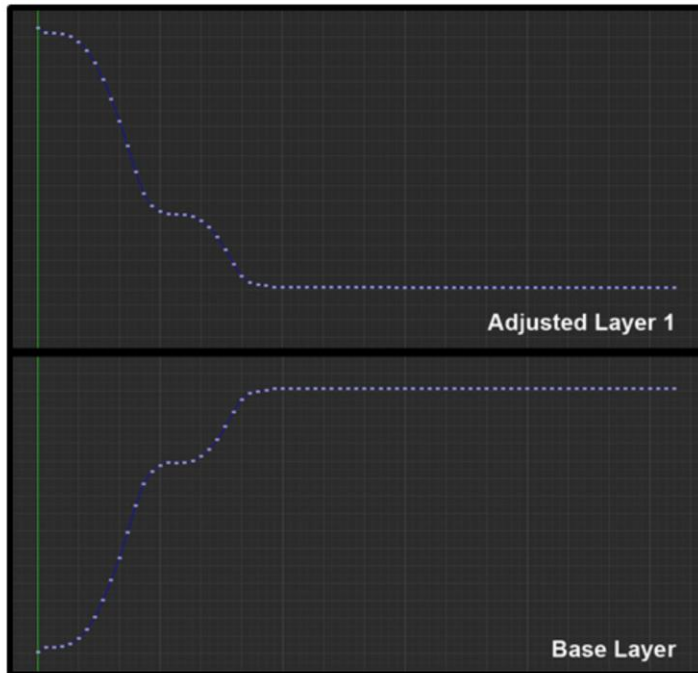
- Then on our layer where we applied our new poses, we just use those same per frame percentage values...



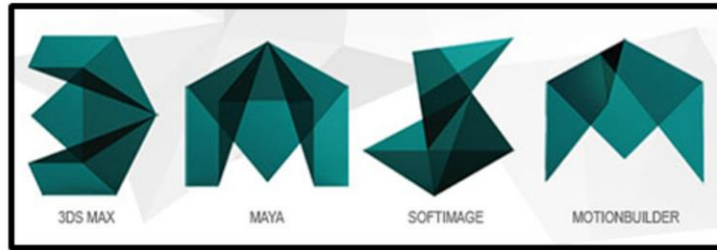
- And that's it... done... we just repeat that same process for every curve.



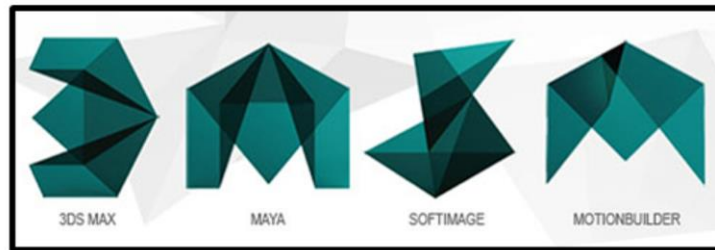
- So if we look at a little before and after and compare our two layers side-by-side.... here's before...



- ...and here's after, so our layer is now only making changes when we already have movement.



- And one of the really nice things about this method... is that it's just math operations on curves... so you can do this in any of the DCCs...



- It also means we can do this at runtime... and I'm going to talk about that later.

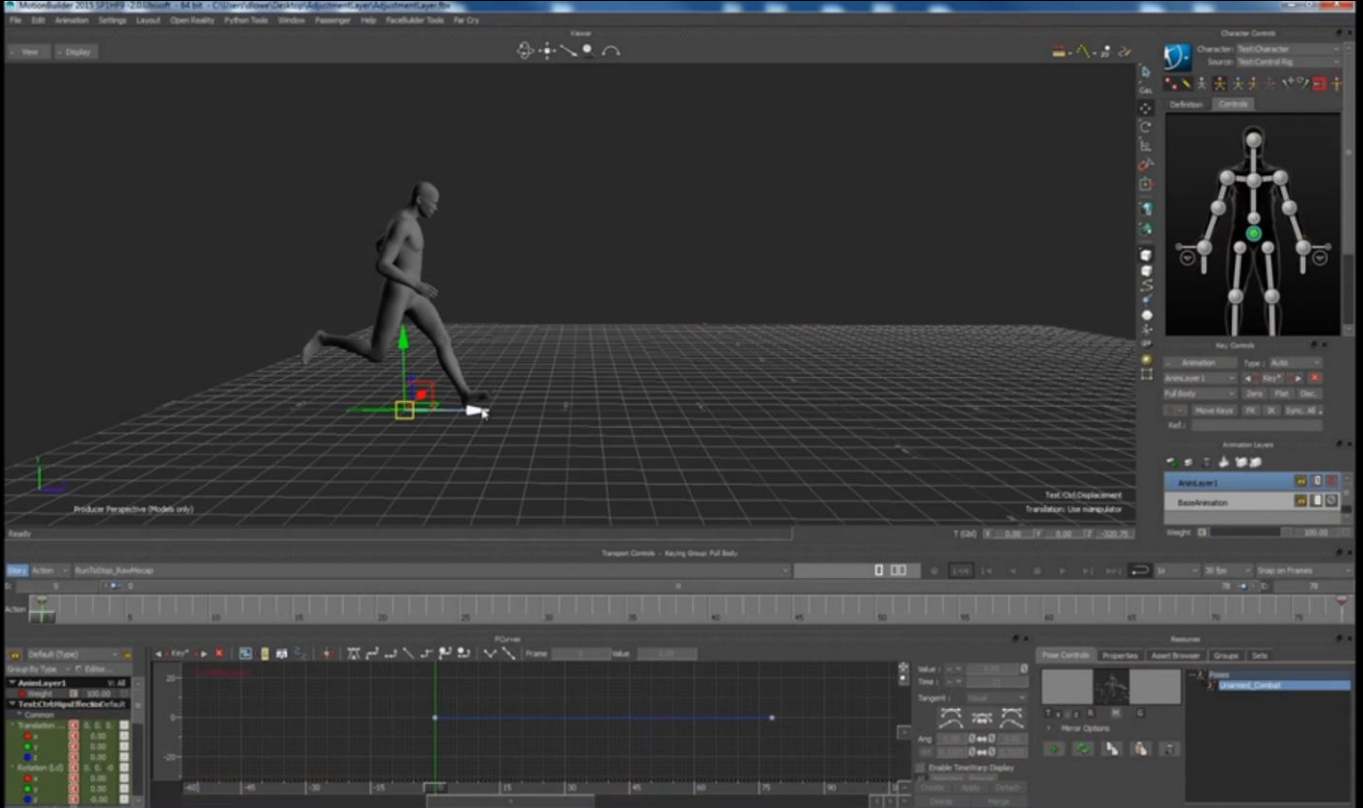
Issues to be aware of

- So just this basic method that I described works pretty well as it is, but there are definitely some issues and limitations to be aware of with this...

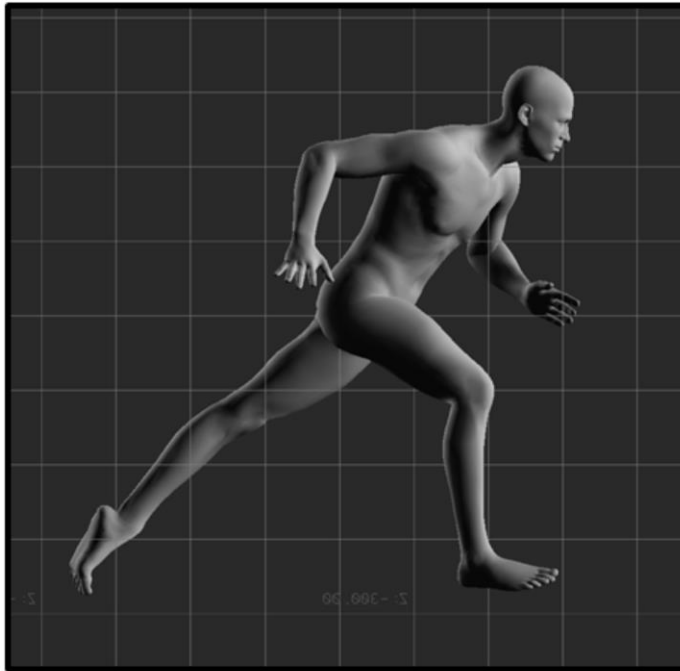
Issues to be aware of

1. Hyper Extension

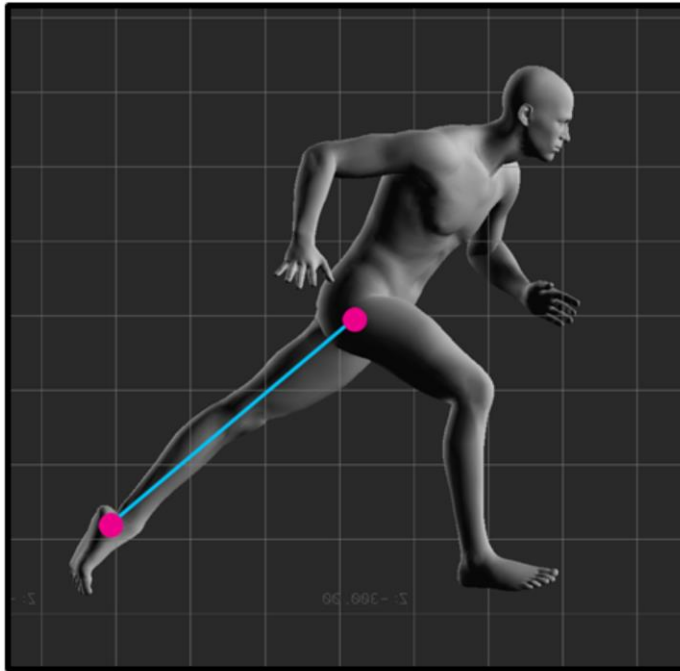
- First is hyper-extension.



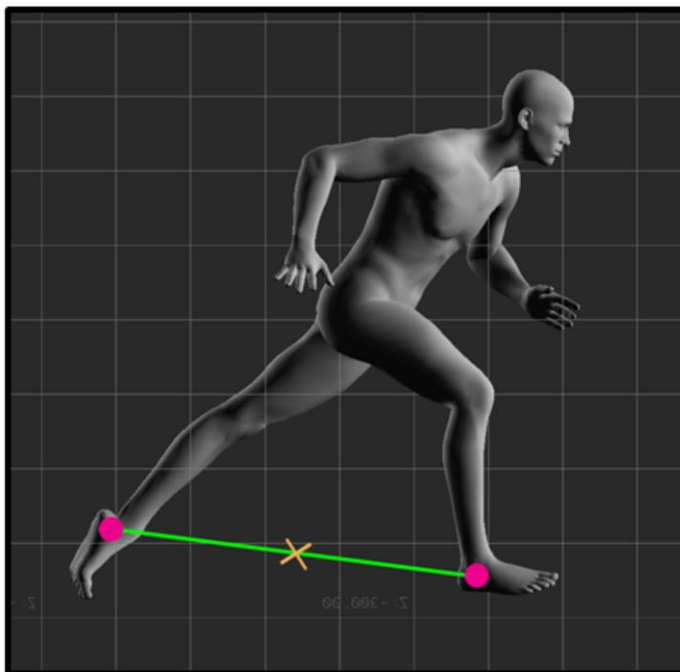
- Any overly large adjustments will lead to hyper-extension on limbs... and this is just a reality of real world body mechanics.
- There's obviously a limit to how far someone can stride.



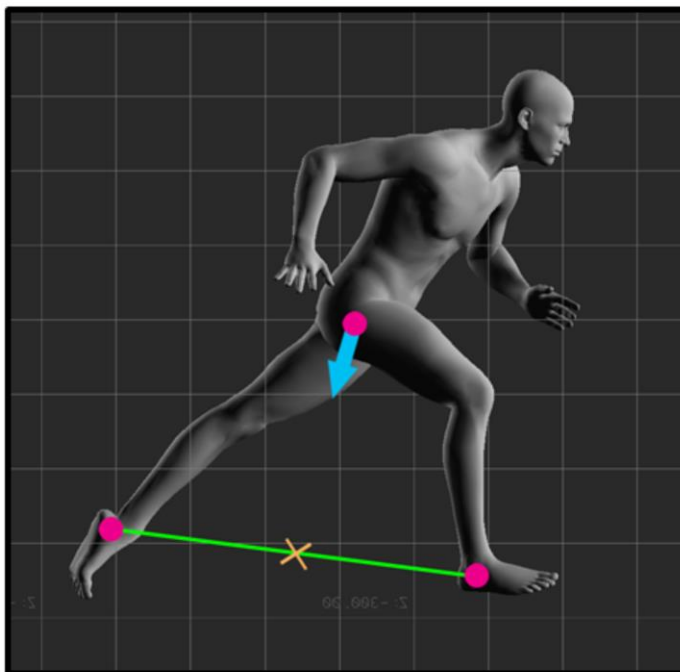
- So we have a fix for this...
- First we have to detect on which frames we have hyper-extension.



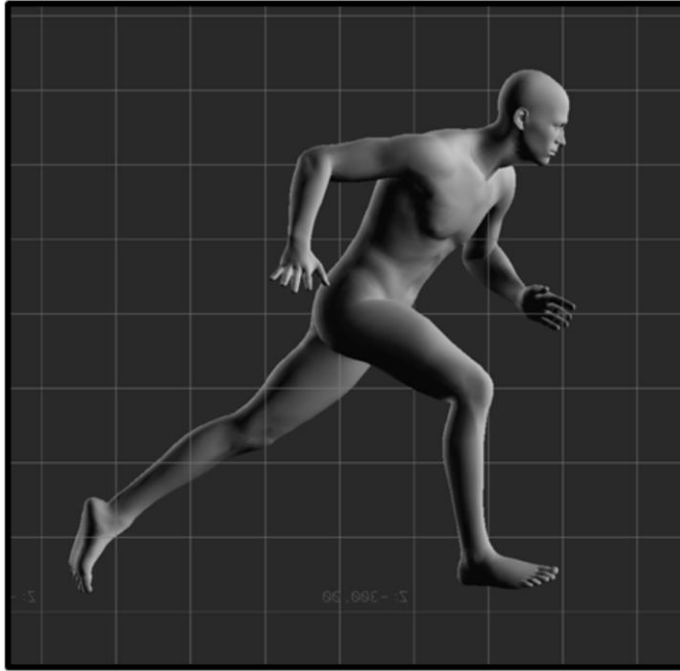
- ...which is pretty easy to do because we know how long our limbs are supposed to be.



- Then we find a point between the two ankles, and the position of this point is dependent on how much hyper-extension we have on each leg. So if we have lots of hyper extension on one leg and no hyper extension on the other leg, this point will be closer to the ankle on the leg that has lots of hyper extension.



- ...and we move the hips towards that point, until we get something that's fixed.

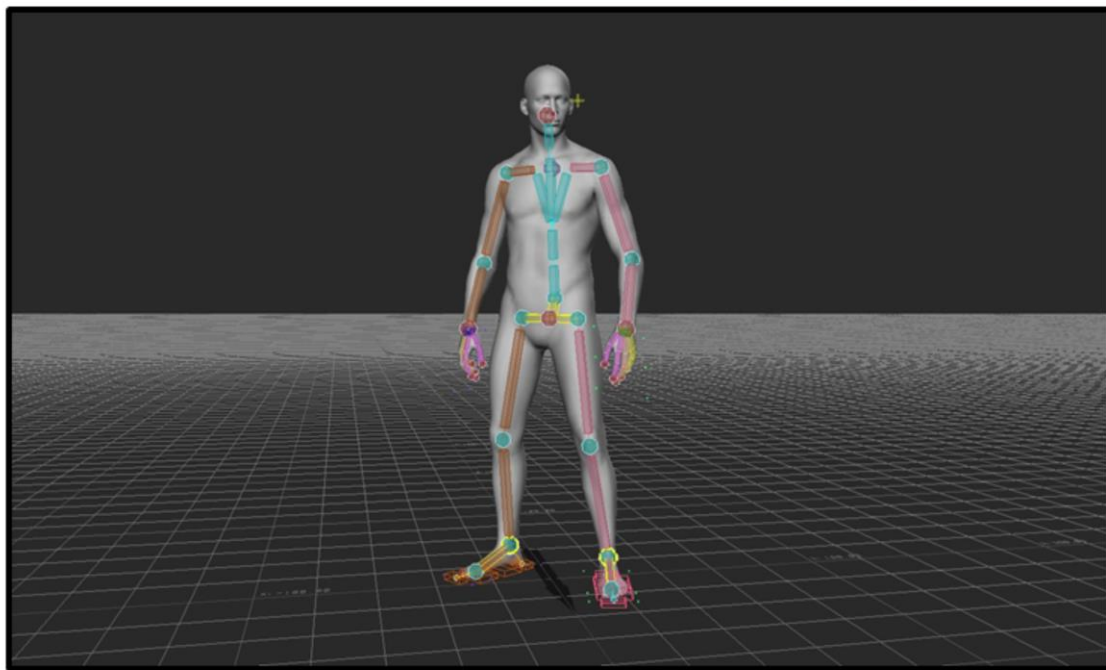


- Like so. That's a very simplified explanation, but it's basically how it works.

Issues to be aware of

1. Hyper Extension
2. Apply to IK effectors for locked contacts

- So the second issue to be aware of with Adjustment Blending, is that to get locked contacts, you need to apply this process to your IK effectors.

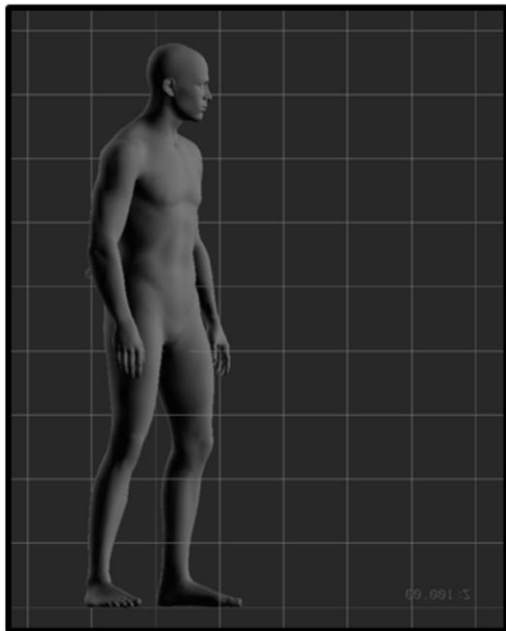


- We're doing this in Motionbuidler, which has a full body IK rig, so we don't have to worry about this. But it going to be something you need to think about if you're doing it in another DCC and especially at runtime.

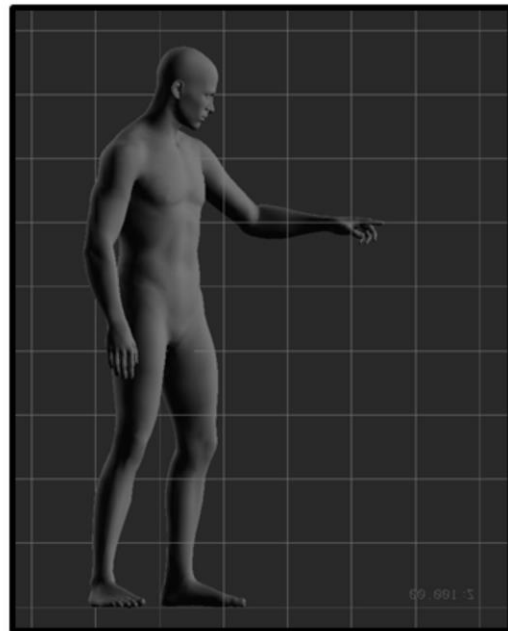
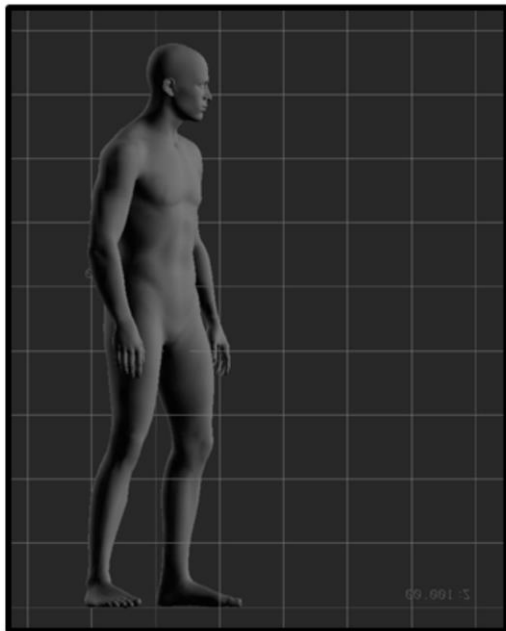
Issues to be aware of

1. Hyper Extension
2. Apply to IK effectors for locked contacts
3. Best when adjusting existing motion

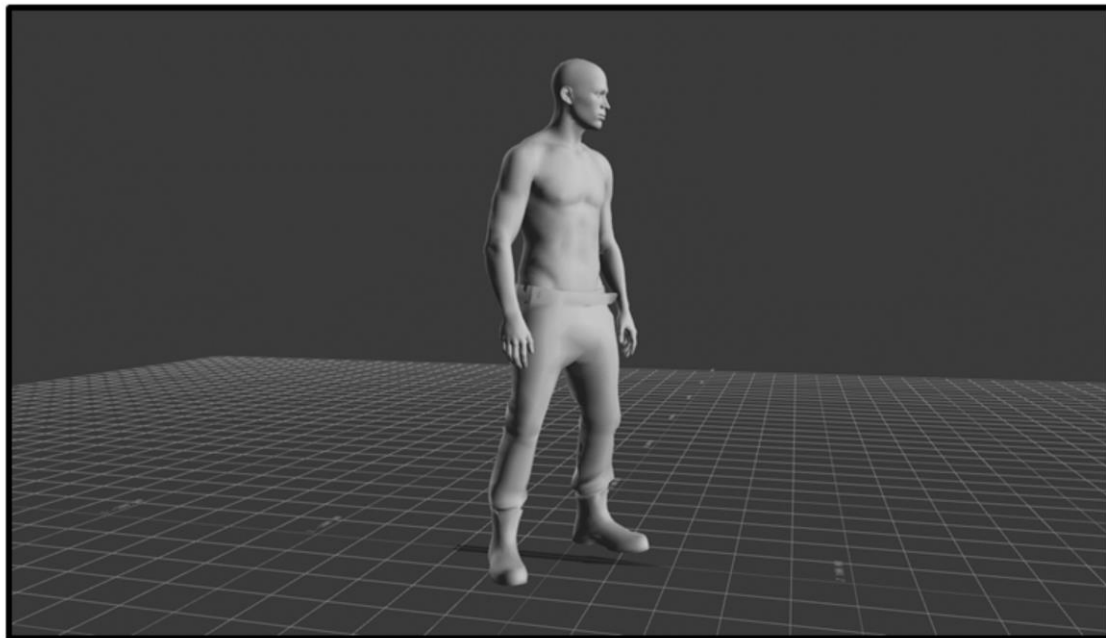
- So last point to be aware of: Adjustment Blending is best when it's adjusting motion that already exists in your base layer, and not really for adding lots of additional motion into the animation.
- So for example...



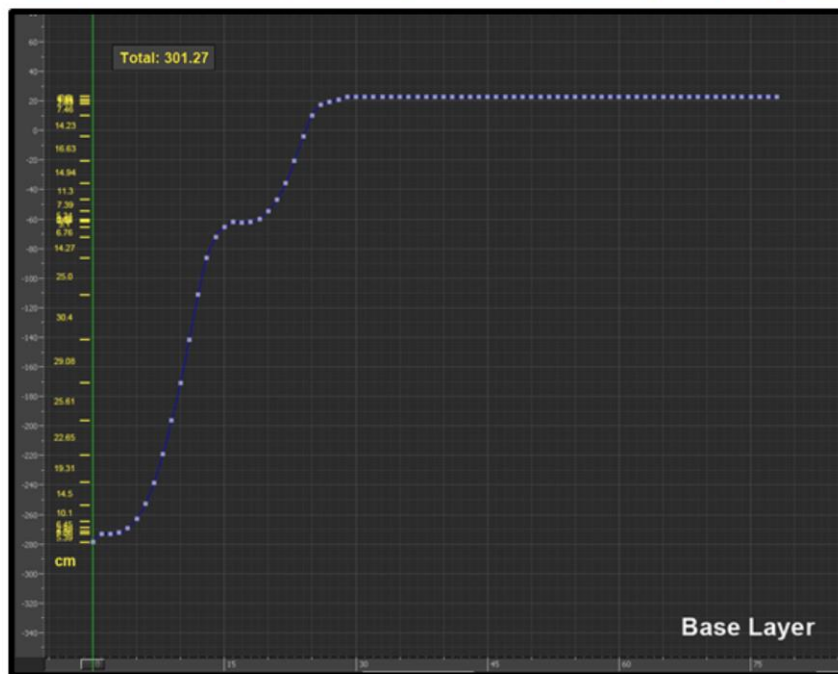
- Say you have a character who's standing idle...and you want to layer on a motion of that character pushing a button...



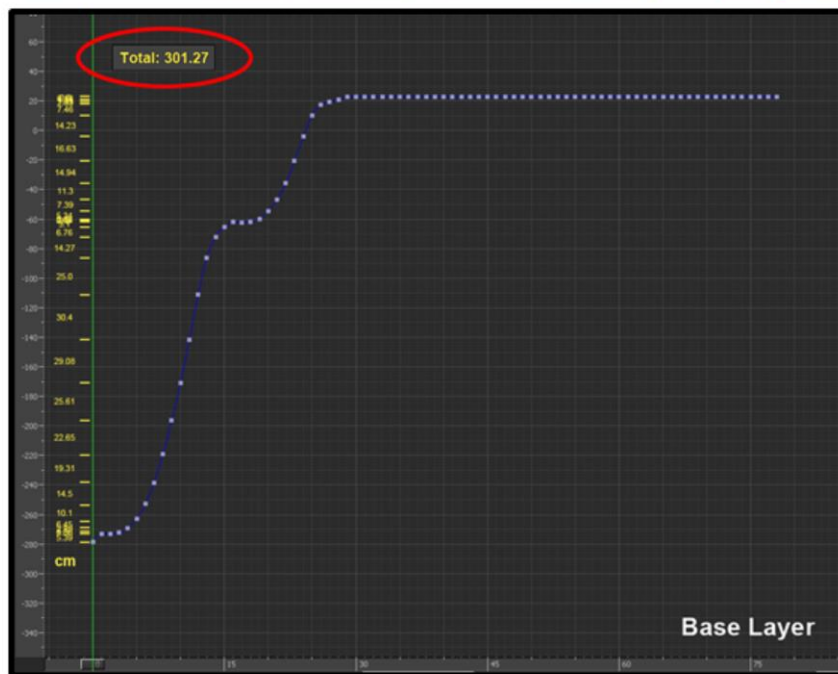
- Since that button press movement on our layer is so much larger than the subtle idle motion on our base layer, the Adjustment Blend is going to have a really hard time trying to find steep curves in which to hide the button press.



- And in fact what actually happens is that when it tries to do this, it ends up giving this really terrible, jerky, intermittent motion. Like this [PLAY]
- So this was actually really easy for use to fix...



- ...If you remember, one of our steps was looking at the amount of motion in the base layer...



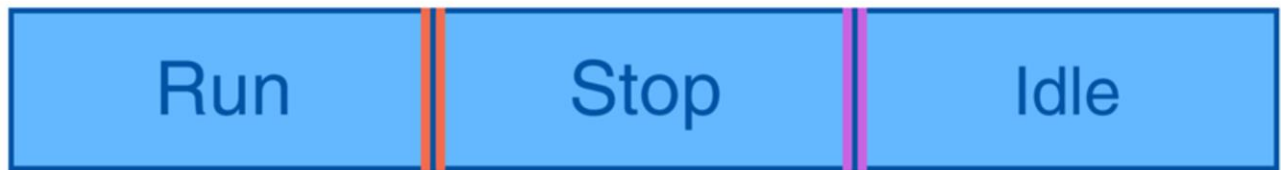
- So we just take this value, and we compare it against the amount of motion we want to add in our layer, and if the amount of motion we're adding is way bigger than the amount in the base layer, we just don't run the adjustment blend on that curve, and that tends to give us better results.

ADJUSTMENT BLENDING AT RUNTIME

- So I mentioned before that we can do this at runtime...
- We have a bunch of programmers looking at this and it's very early days, but for me this is where this gets really interesting, so I wanted to talk about some of the potential use cases.



- So say we have a character that is running in our game... that goes through this sequence of animations... run, then stop, then idle.
- Normally this would come with a bunch of challenges...



- First we have to make sure our start and end poses match correctly...



- ...we also don't know exactly what pose we're going to be on when the run animation gets the signal to stop, so we'd usually see some blending problems in this area.



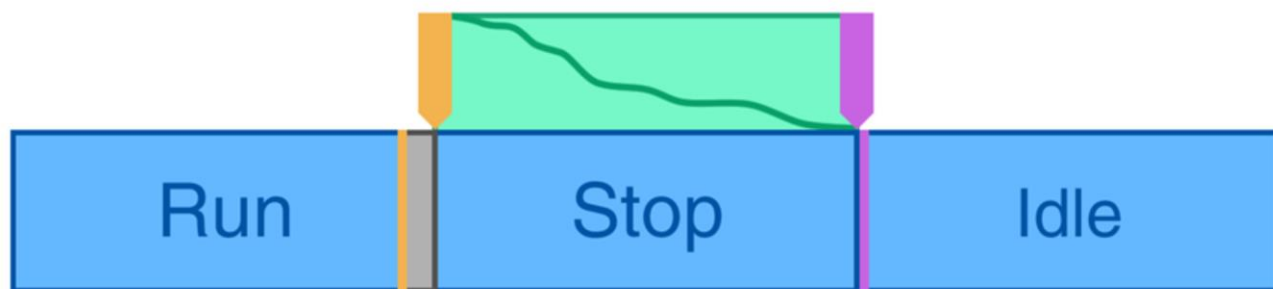
- And then also if it's an AI, we often want our characters to stop on an exact point at the end of a path, so we usually have to do some sort of distance or turn correction, which causes sliding, which we don't want.



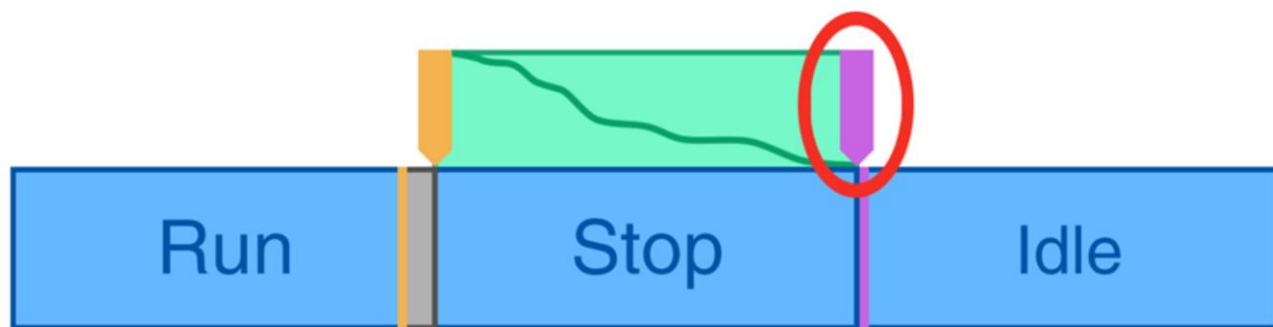
- So what we'd do with Adjustment Blending is at whatever point we interrupt our run, we extract that pose.



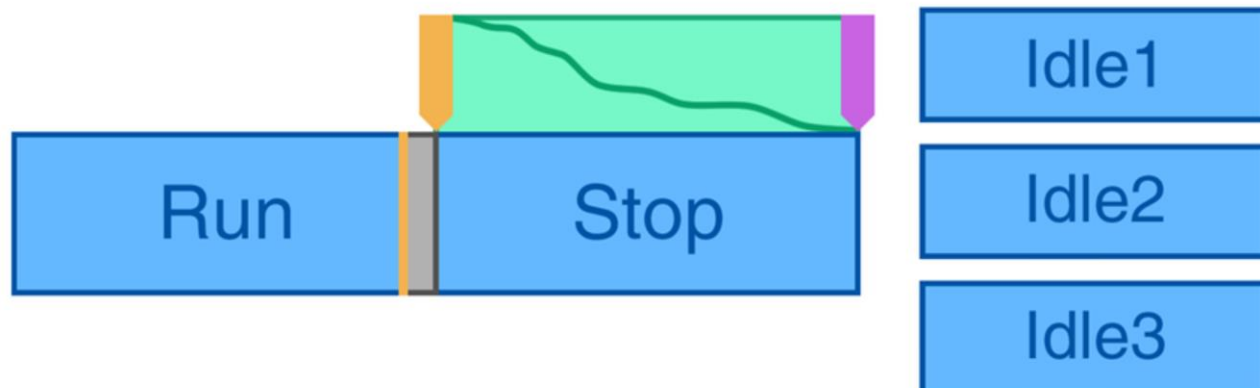
- We then look at the Idle pose that we're about to blend into and we extract that pose too.



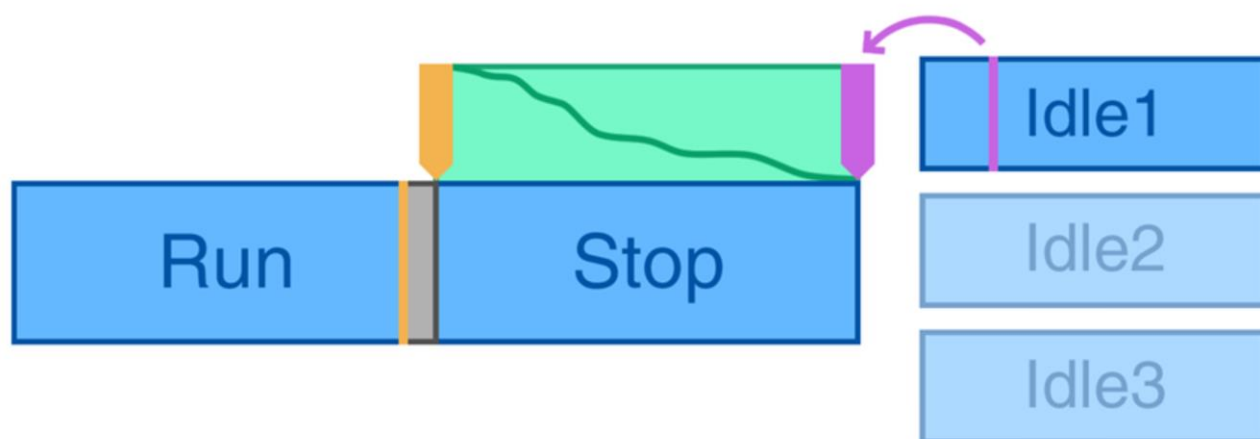
- And then... at runtime, we generate an additive layered animation using the Adjustment Blend algorithm, which we then play over our stop, which corrects for the poses.
- What's awesome about this...



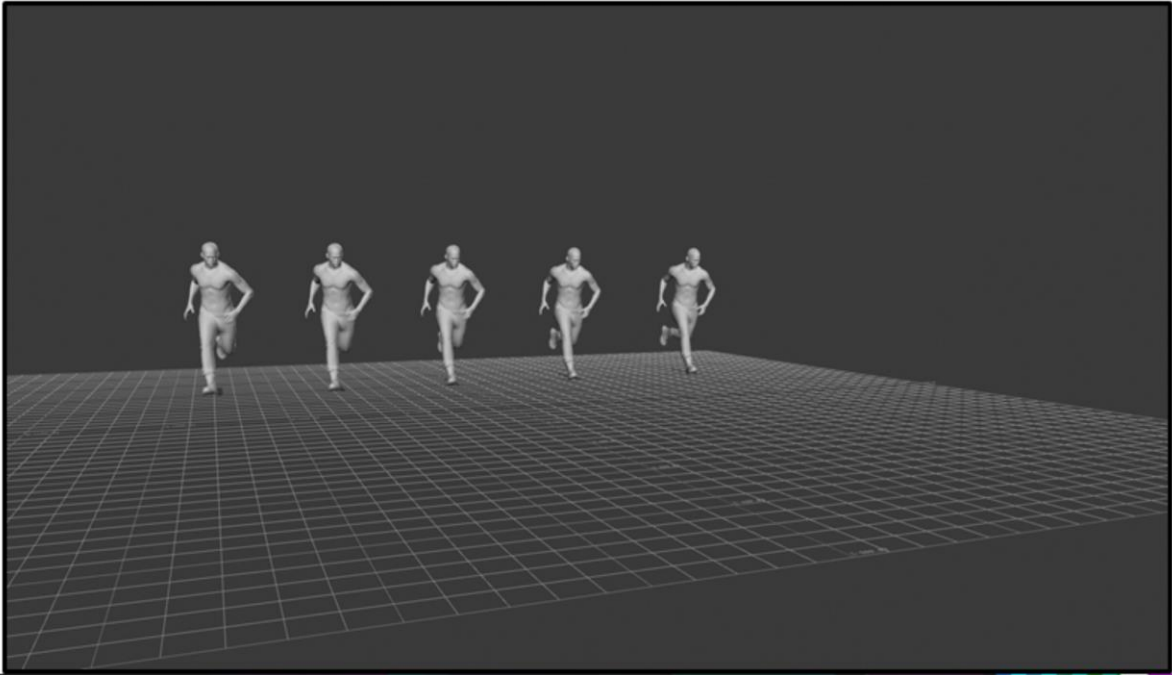
- ... is that since this pose here is extracted, we no longer need to have a consistent Idle pose that we standardize across all of our base data.



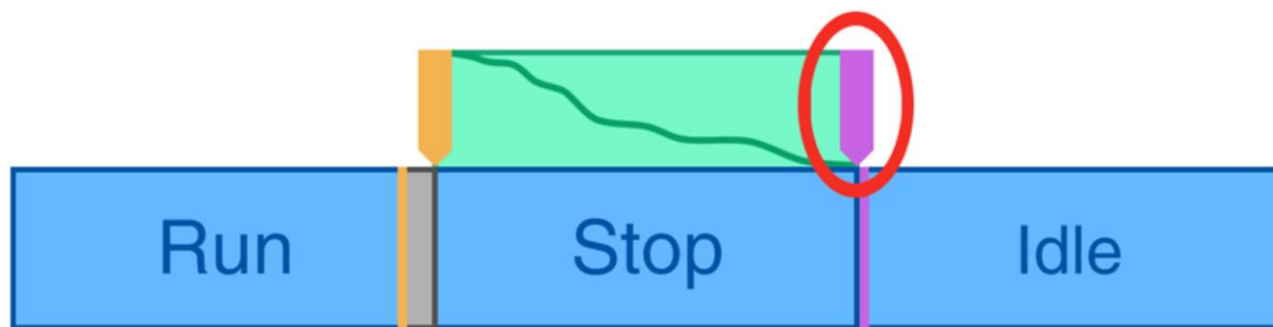
- We can actually have a bunch of different Idles and every time we stop we can randomly select one...



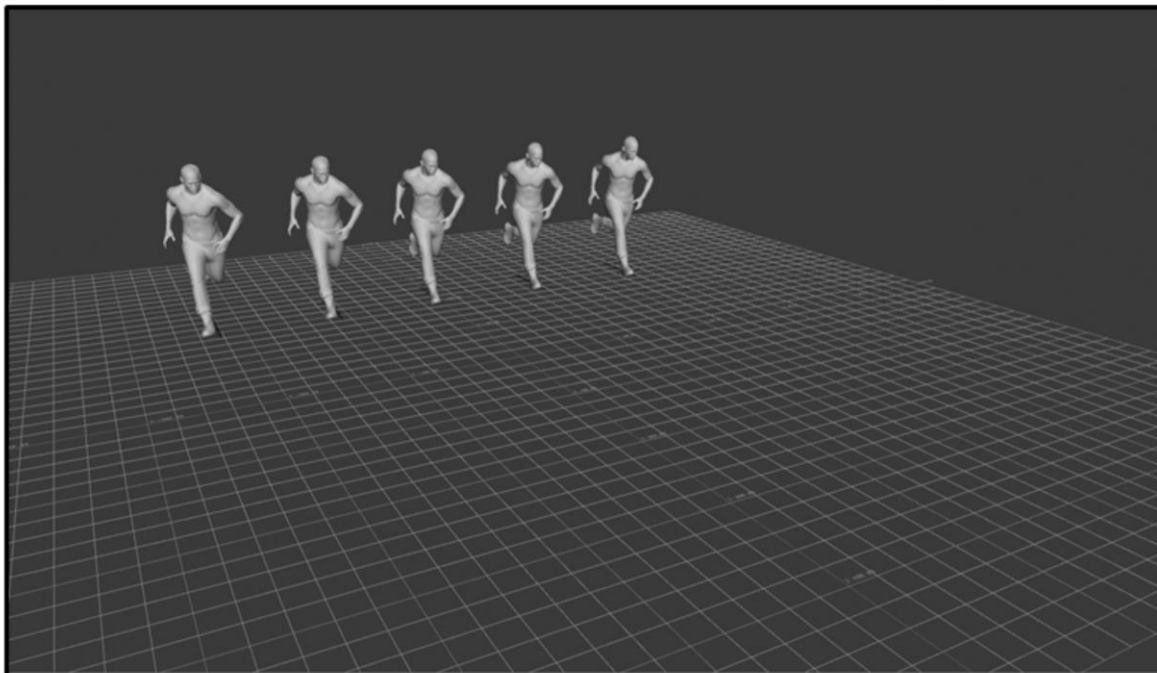
- And we can also randomly pick a start time I we wanted to... and the Adjustment Blend is going to deal with it.



- So here's an example of that. [Video shows 5 characters running to a stop and taking different Idle poses. Everything looks natural, there's no foot slide]
- All of these guys are actually using the same stop animation, and it's only the Adjustment Blend that is pushing them into the Idle pose.



- We can also grab this pose and reposition it in the world before we generate the blend, and this way we can get some degree of distance and rotation correction.




- And again... [Video shows 5 characters running to a stop, but stopping at different distances and turn angles. Again, everything looks natural, there's no foot slide]
- ...same stop animation, we're just moving the end pose and then running the Adjustment Blend.



- So this got me thinking, normally our characters move by sequencing these short animation clips, and we keep these clips short because our systems need to be dynamic.
- But if you have really good correction, which is what adjustment blending gives us, then for AI, where we have some idea ahead of time, of where the character is going to move... you could actually stay in the same animation and then use the Adjustment Blend to give your system that same dynamism.
- So what I mean by this is that you could take this whole sequence of animation clips, and instead...

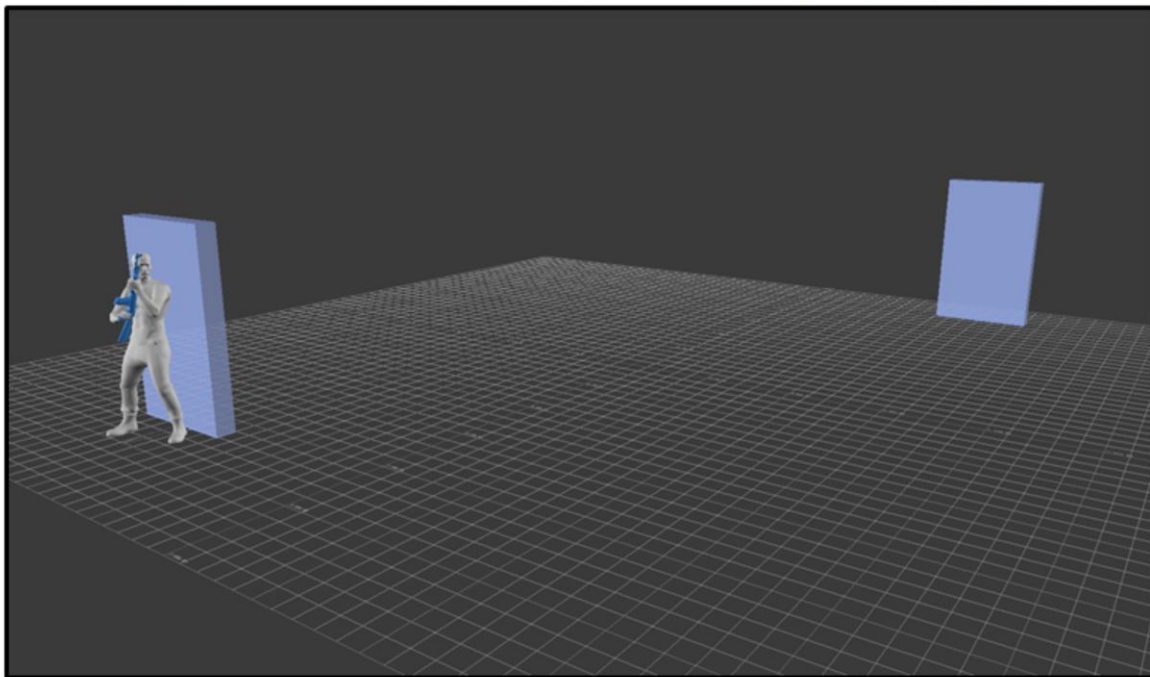
Run Point To Point

-start to use much longer clips of data that do the job of all of those shorter clips...

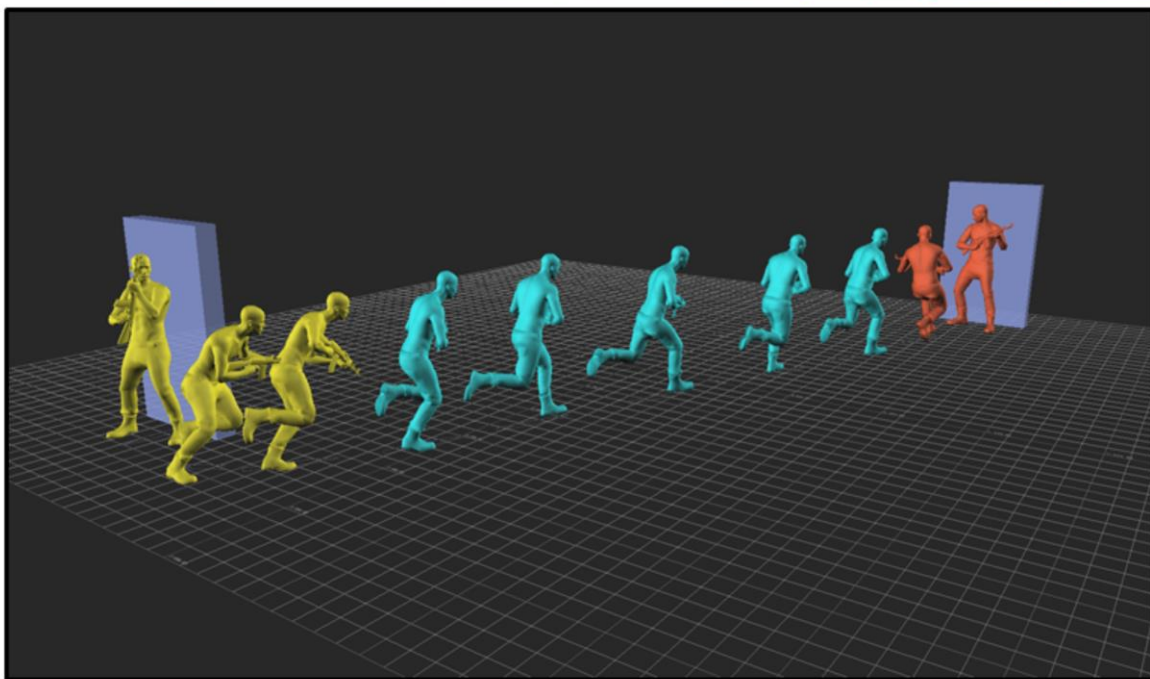


Run Point To Point

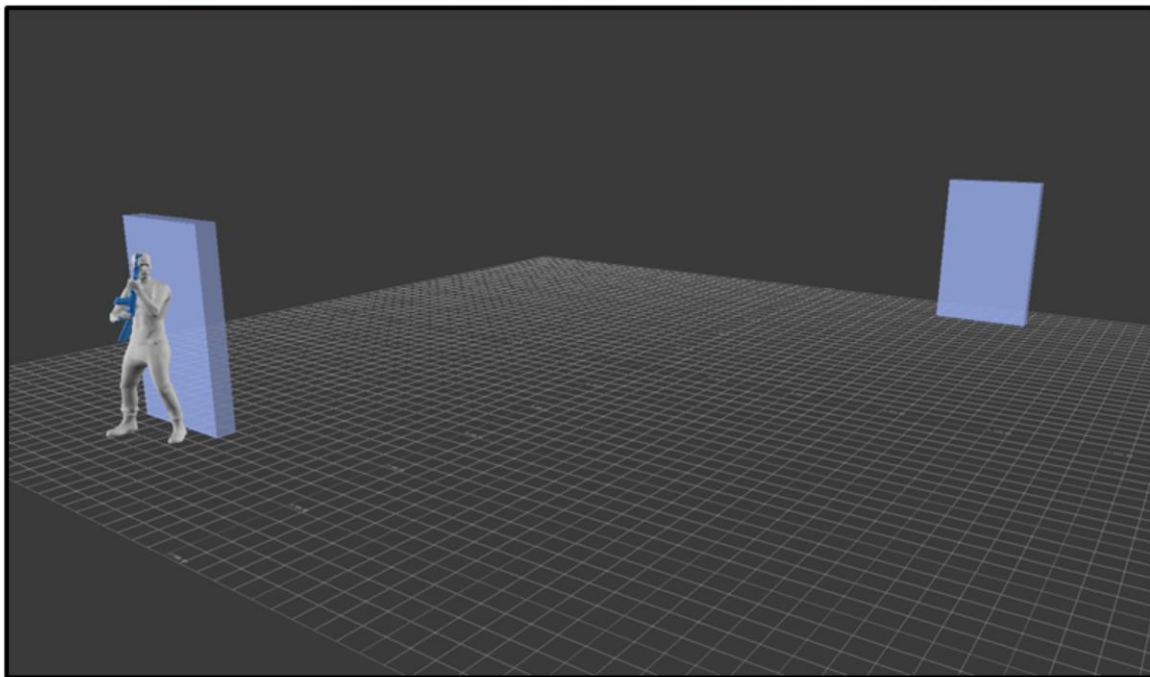
- ... and then use the Adjustment Blend to correct for whatever situation you have.
- So here's an example...



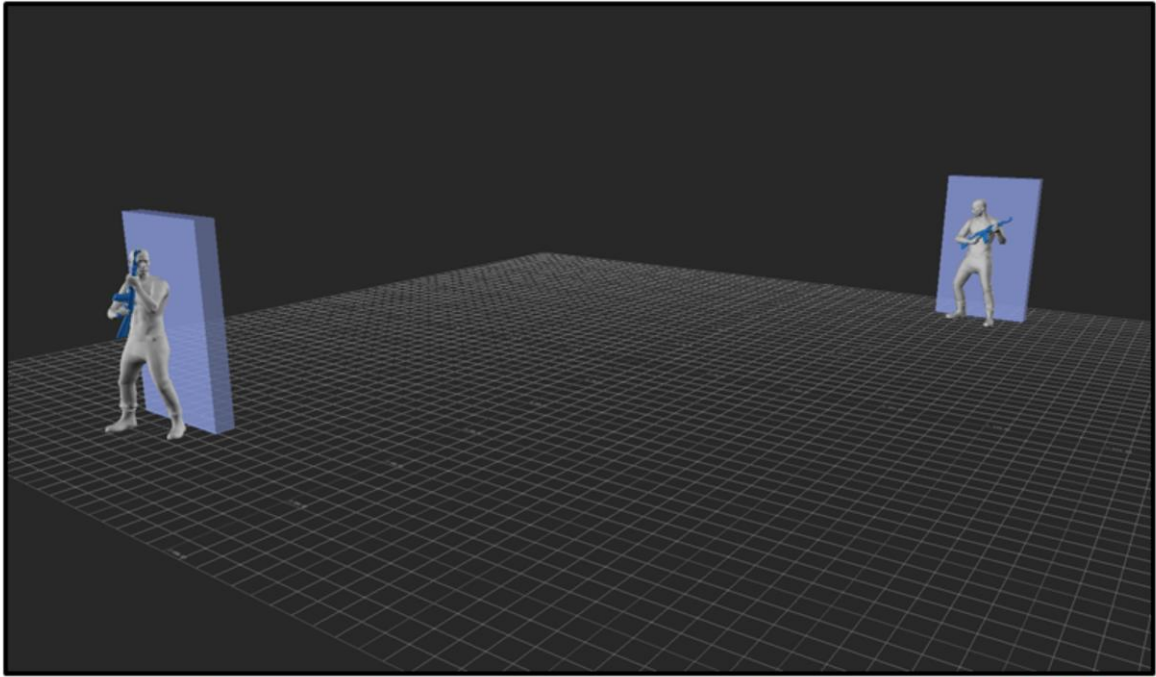
- Here we have a character moving from one piece of cover to another, and this is one long piece of mocap, so it's kind of like what we'd get from the mocap stage before we do anything to it.
- [Video shows character running from cover to cover. The motion is clean and looks like uncut mocap.]
- And we have this really nice movement, where he accelerates and decelerates properly, and it all feels like it's in context with his environment.



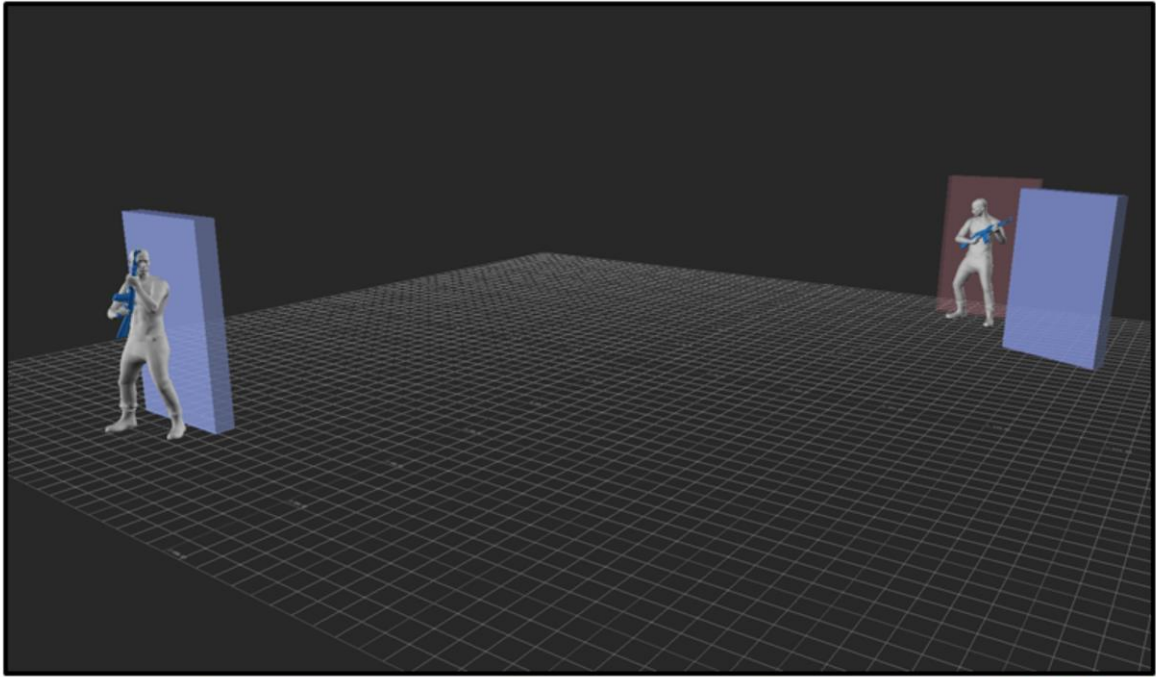
- But normally, what we would have to do is to separate this out into smaller clips.
- So we have a Cover Exit animation, then we'd go into standard locomotion, then we'd have a Cover Entry animation.



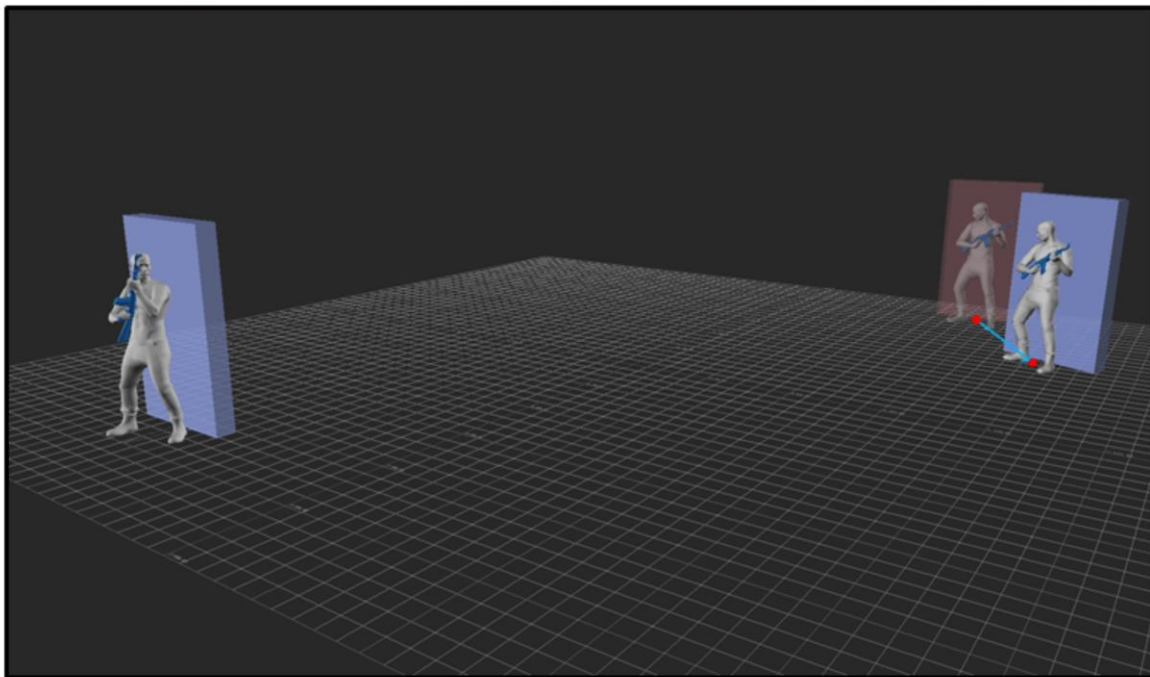
- [Video shows character running from cover to cover, but the motion doesn't look as nice as before. There are subtle differences in the motion and subtle blend artefacts]
- And we lose something here... the standard locomotion doesn't feel as quite as appropriate for this context... the blends between the clips can cause problems... and maybe we have to slide on the Cover Entry to correct for distance.



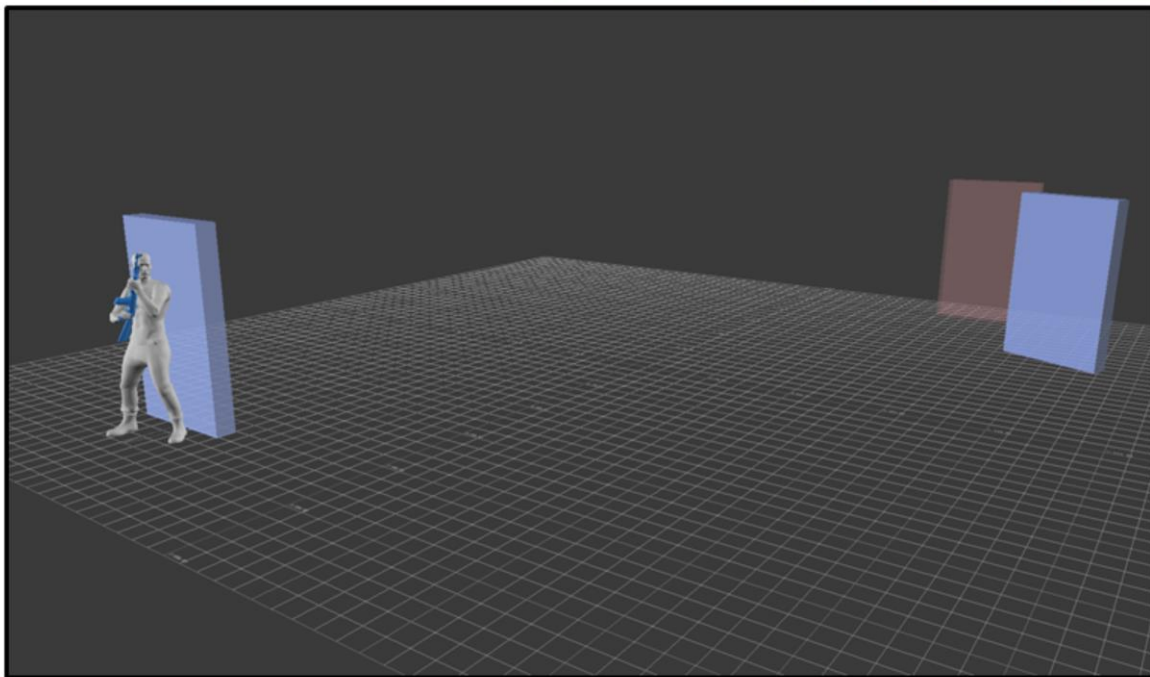
- So say now we go back to our original long mocap clip...the one that we like...



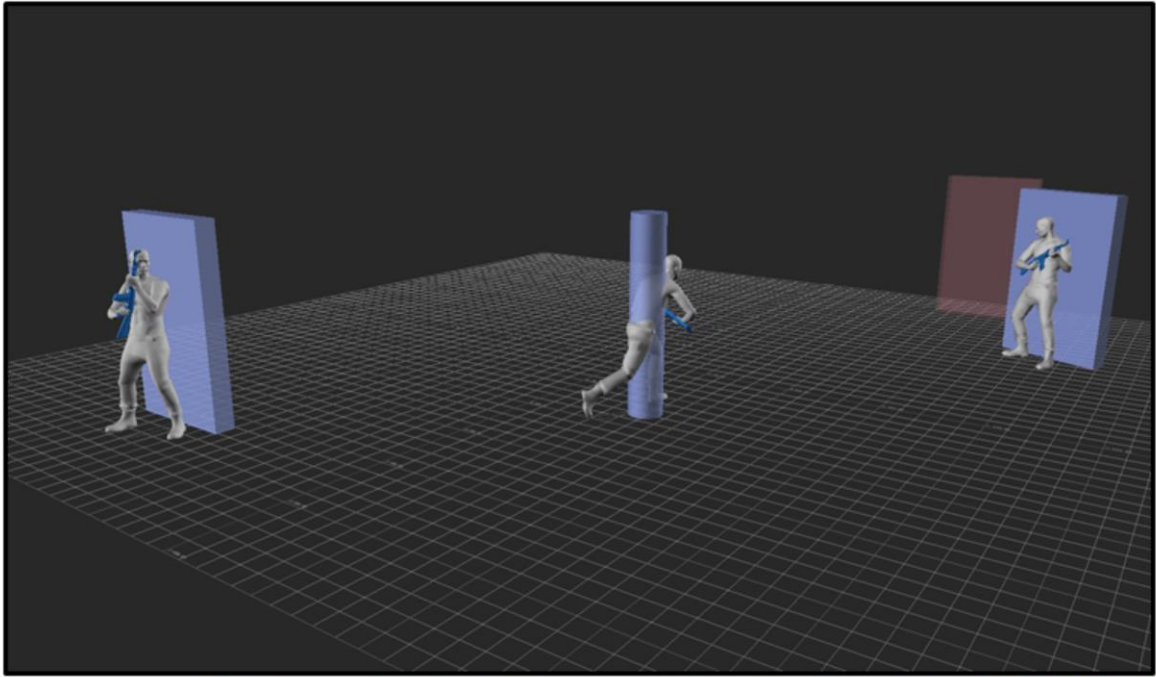
- ...but say that our target cover isn't exact where we want it...



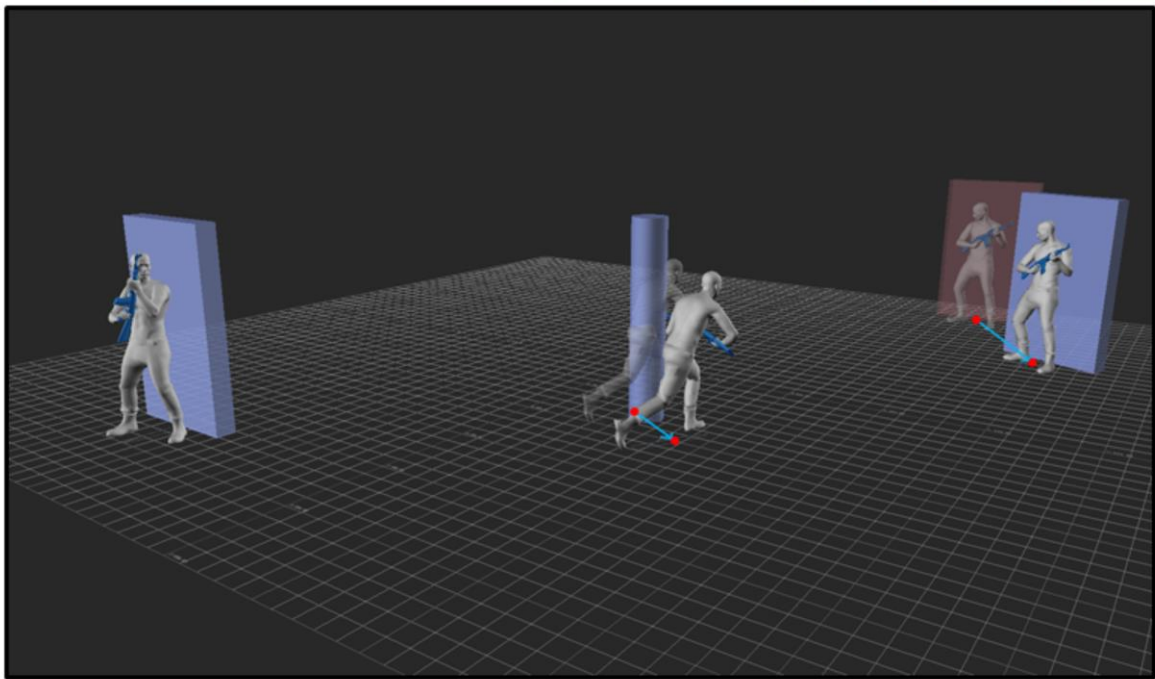
- ...we can grab that last pose and move it into position... then we run the Adjustment Blend on it...



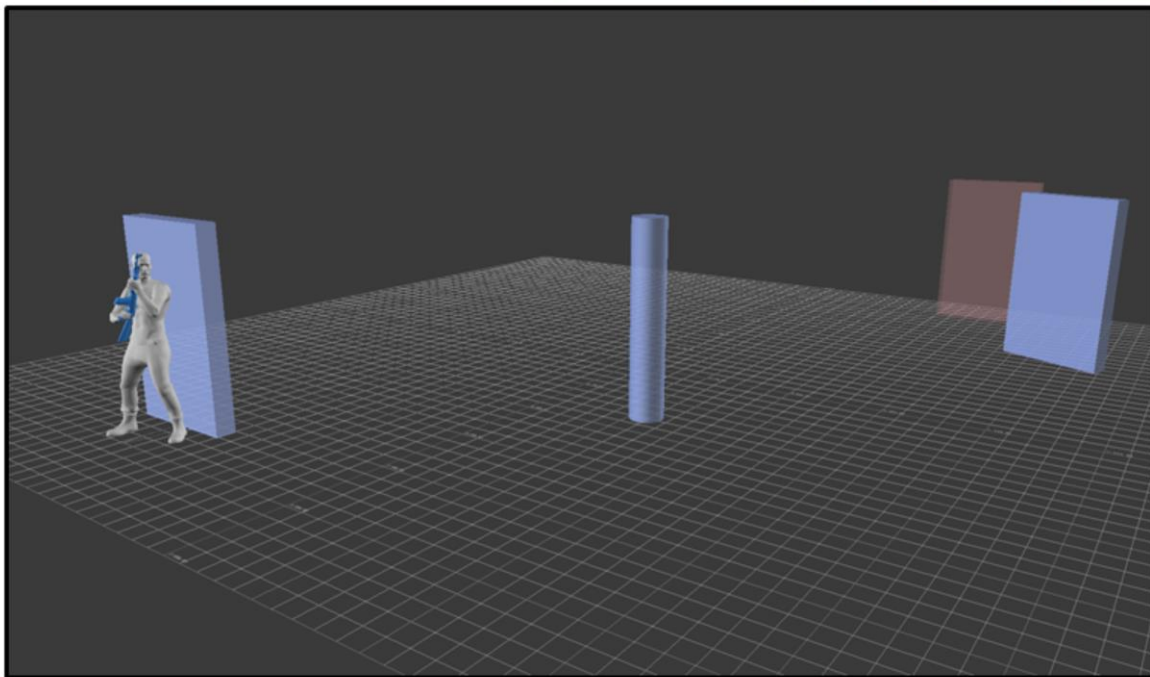
- [Video shows character running from cover to cover, and has the same quality as the original uncut mocap clip, but is now corrected to the new cover point. Everything looks natural, there is no foot slide.]
- ...and there we go... within a certain threshold we can correct for this difference in the target position, and this allows our cover system to work in different situations.



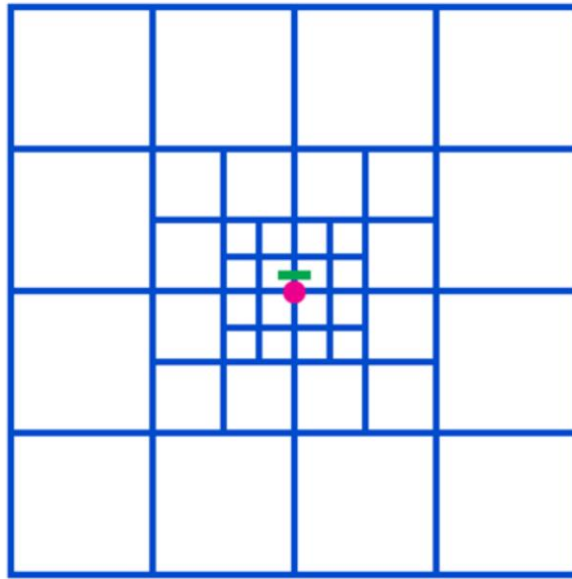
- We can also warp around obstacles to some degree, we just take sample poses along the path...



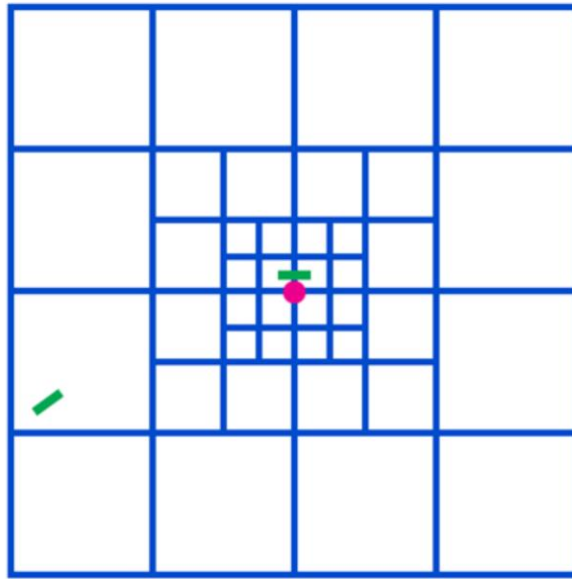
- ...and then do multiple adjustment blends.



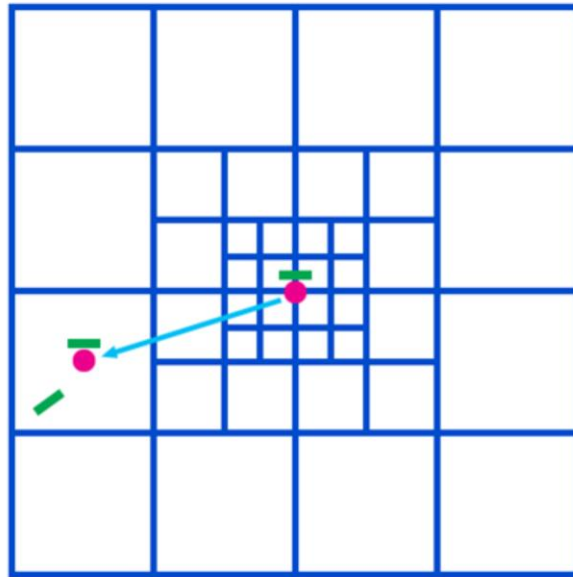
- [Video shows character moving from cover to cover and curving to avoid the obstacle. As before, it looks natural.]
- Like so.



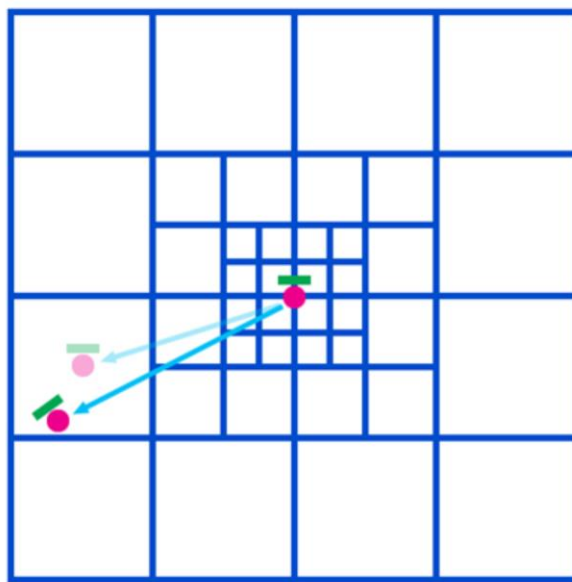
- You would have to build a grid of coverage because there's only so much we can correct... so each of these squares represents one animation....



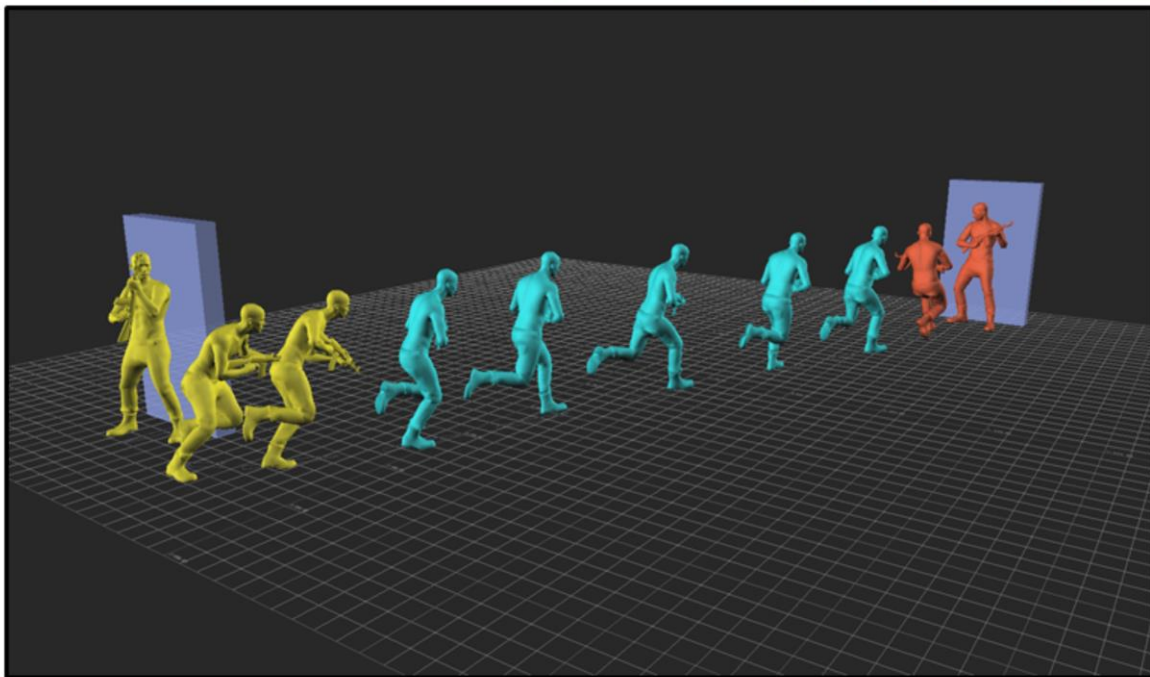
- ...and then you look for your target cover node...



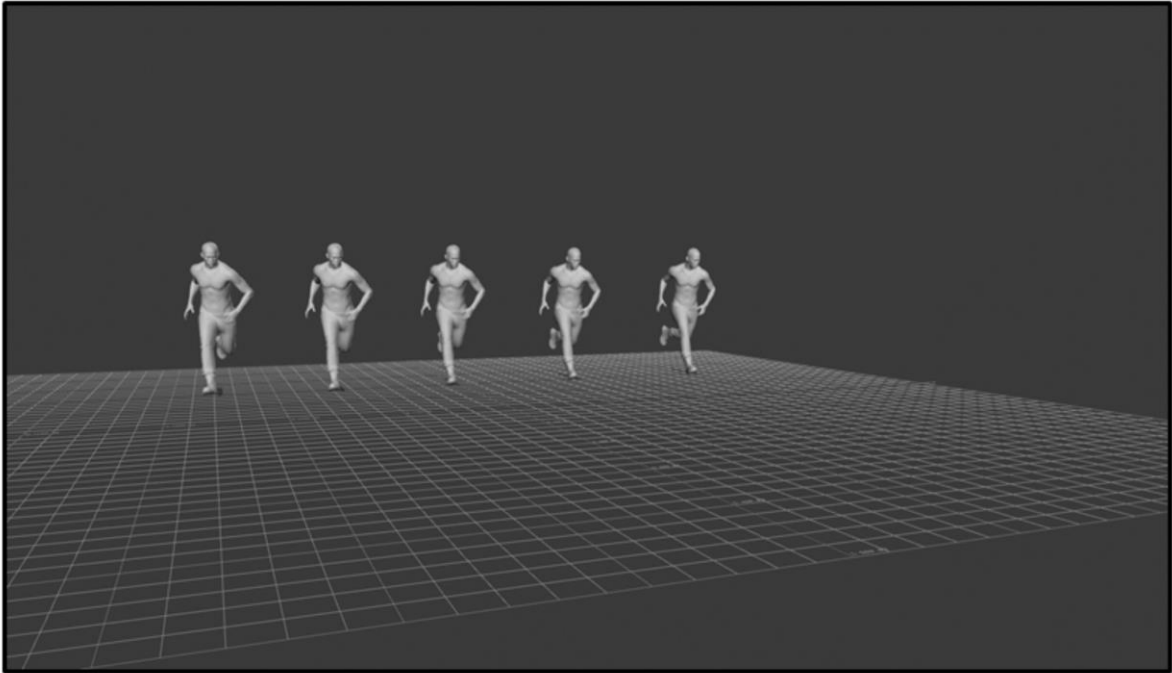
- ...and then find the closest animation...



- ... and correct this to where we want it.
- And this might seem like a lot of coverage, but this stuff is super easy to shoot on the mocap stage, because I don't have to worry about footstep matching or any of the usual technical constraints.
- I just set up the cover objects and just tell the actor, I need you to get from here to here, and I don't care how you do it, just focus on the performance.



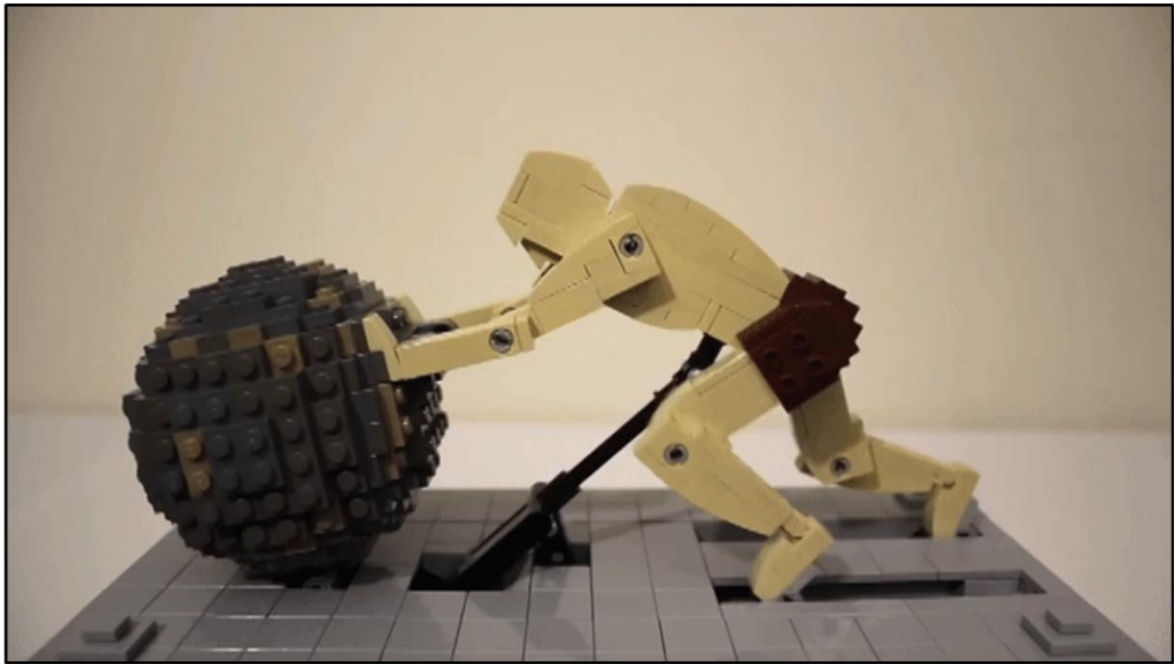
- You would still need a regular locomotion system to fall back on, because you're always going to have interruptions, or if you have to do lots of turns... like if you're making a game with lots of corridors or an environment that's very dense with obstacles, for example, then maybe this isn't the best choice...but in a game with relatively open spaces I think you'd see a real quality bump from this.



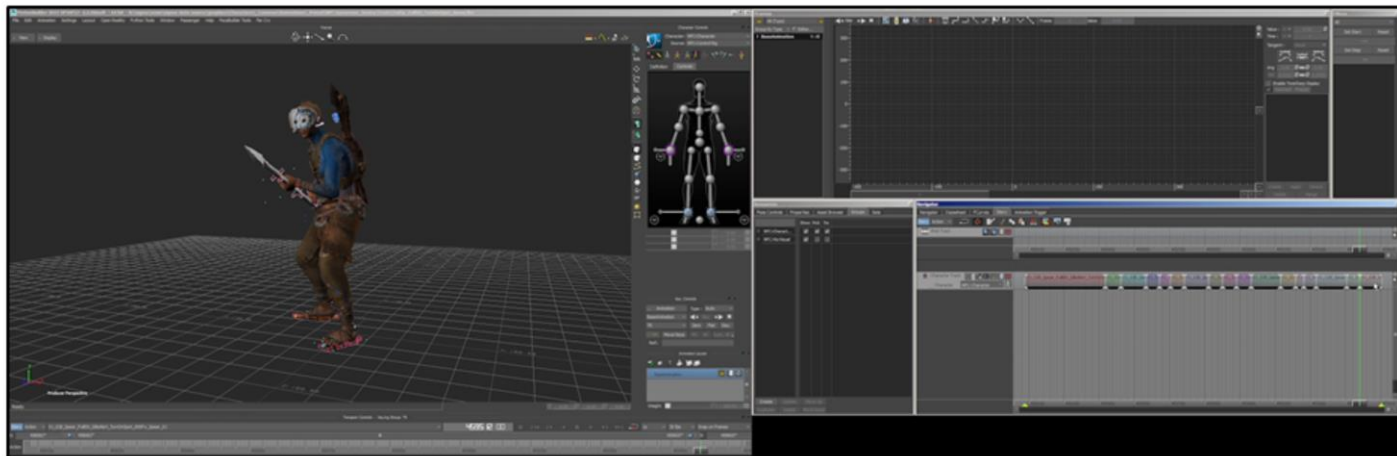
- [Video repeats adjustment blend examples from earlier]
- So that's Adjustment Blending.
- We used the offline version of this a ton on Far Cry: Primal, and it really helped to improve productivity for our animation team.
- The thing is, there's nothing especially clever about Adjustment Blending. The philosophy was really just "Do exactly what our animators are already doing... just write a script to automate it".
- And so we started thinking... What if we took that same philosophy... and applied it to the entire motion editing pipeline?

AUTOMATION TOOLS

- So we estimate that Adjustment Blending saved us about 15% productivity for all of our animators, which might not sound like a lot, but there are a lot of animators Ubisoft, cleaning up a lot of mocap, and so that 15% represents a lot of time and energy being saved.



- So around the time that Primal was hitting alpha, I went to Ubisoft's Technology Group, and proposed this mandate of looking at the entire mocap pipeline to try and get a better idea of how inefficient we're being as mocap animators, and to then investigate how we could push that 15% productivity saving higher by automating other tasks.



- [Video shows sped up version of me animating and recording my workflow].
- So I first started by doing an analysis of our current pipeline, which basically involved me sitting down... recording myself working... and making comments about what I was doing as I was doing it.

TurnOnSpot_Analysis.xlsx (Read-Only) - Excel				
	A	B	C	D
89	00:11:50	Scrub clip back and forth to check that animation and character extensions went into the story editor correctly (undo scrub after)	Motionbuilder	00:00:07
90	00:11:57	Identify animation start and end frames in the mocap story clip and razor at those points (leave 15 frames after cut frame on settings)	Motionbuilder	00:05:10
91	00:17:07	Select unwanted clips in the story editor and delete	Motionbuilder	00:00:09
92	00:17:16	Drag each clip to its own Character Animation Track and zero the start time on each clip	Motionbuilder	00:00:38
93	00:17:54	Set the character drop down for each Story Editor track to our character	Motionbuilder	00:00:12
94	00:18:06	Check in viewer	Motionbuilder	00:00:14
95	00:18:20	Mute all Story tracks except the first	Motionbuilder	00:00:12
96	00:18:32	Create a new take for each story track	Motionbuilder	00:00:14
97	00:18:46	For each Story clip, switch to a new take, turn on ghosting, roughly align rotation, frame start and end, and plot scene to current take	Motionbuilder	00:01:11
98	00:19:57	After 3 Story clips I Save As, just as a backup (this can be ignored for automation) (Junk Task)	Motionbuilder	00:00:11
99	00:20:08	Continue switching to new take, turning on ghosting, aligning rotation, framing start and end, and plotting to current take	Motionbuilder	00:02:44
100	00:22:52	Delete all track from the Story Editor	Motionbuilder	00:00:11
101	00:23:03	Uncheck Transparency Selection	Motionbuilder	00:00:01
102	00:23:04	Select the Displacement	Motionbuilder	00:00:01
103	00:23:05	In the curve editor, select curves for automatic rotation and translation, select all keys, and set all keys to 1 to activate	Motionbuilder	00:00:08
104	00:23:13	Checked result and realized automatic rotation would be better with a rotation constraint in this case, because the stance of the character	Motionbuilder	00:00:04
105	00:23:17	Select the Displacement (Junk Task)	Motionbuilder	00:00:01
106	00:23:18	In the curve editor, select curve for automatic rotation, select all keys, and set all keys to 0 to deactivate (Junk Task)	Motionbuilder	00:00:06
107	00:23:24	Add a rotation constraint	Motionbuilder	00:00:08
108	00:23:32	Select Displacement and rotate it to match desired facing direction of character	Motionbuilder	00:00:05
109	00:23:37	Select and drag Displacement to Constrained Object in rotation constraint	Motionbuilder	00:00:05
110	00:23:42	Select and drag Spine1 effector to Source (Parent) in rotation constraint	Motionbuilder	00:00:07
111	00:23:49	Activate rotation constraint using Snap, then Lock	Motionbuilder	00:00:02
112	00:23:51	Check result across several takes	Motionbuilder	00:00:09
113	00:24:00	Go through each take and in the Curve Editor, select automatic translation, select all keys, and set all keys to 1 to activate	Motionbuilder	00:00:40
114	00:24:40	Select Displacement	Motionbuilder	00:00:01
115	00:24:41	Do Plot Selected (All Properties), with Plot All Takes checked and with key reduction turned off	Motionbuilder	00:00:08
116	00:24:49	Select Displacement	Motionbuilder	00:00:01
117	00:24:50	Turn off rotation constraint (Junk Task because I'm about to delete it)	Motionbuilder	00:00:05
118	00:24:55	Go through each take and in the Curve Editor, select automatic translation, select all keys, and set all keys to 0 to deactivate	Motionbuilder	00:00:31
119	00:25:26	Delete rotation constraint	Motionbuilder	00:00:05
120	00:25:31	Open Groups, uncheck Pick on Viz/Meshes, and select meshes that we don't want to see (in this case sandals and mask) (Junk Task - Bad Visual Setup)	Motionbuilder	00:00:19
121	00:25:50	Add a new group (with meshes selected), and rename to something appropriate (Junk Task - Bad Visual Setup)	Motionbuilder	00:00:07
122	00:25:57	Uncheck visibility on the new group, then recheck Pick on Viz/Meshes (Junk Task - Bad Visual Setup)	Motionbuilder	00:00:03

- I then I would go through the recording and note down everything that I was doing, down to individual clicks in some cases, and then I'd also note down how much time I was taking to do each action.

Totals	Total Times	% of Total Time	Ease of Automation
Junk Tasks	00:06:56	9.83%	Unnecessary
Find and open correct mocap file in mocap delivery directory	00:02:13	3.14%	Very Hard
Update rigs in the mocap file to latest/assetized rigs	00:04:47	6.78%	Easy
Transfer animation data to new rigs in a clean file	00:02:22	3.36%	Easy
Fix viewport performance issue	00:01:28	2.08%	May be unnecessary
Scene/File/Application Clean-up	00:04:57	7.02%	Easy
Select clip ranges	00:05:10	7.33%	Hard
Process mocap from one long take to short animation clips	00:05:58	8.46%	Easy
Animate the displacement to match character movement	00:08:42	12.34%	Medium
Build a weapon heirarchy for better interpolation during edits	00:04:08	5.86%	Easy
Merge and update poses from Pose Bank	00:01:13	1.73%	Easy
Apply key poses	00:05:48	8.23%	Medium
Fix glitches in pose adjustment	00:07:11	10.19%	Hard
Center the character in the scene	00:03:32	5.01%	Medium
Setup Export Nodes and Export animations	00:02:22	3.36%	Easy
Dampen hand and finger motion	00:03:43	5.27%	Easy
TOTAL	01:10:30		

- So then I took all these individual little actions, and I grouped them into these high level goals, like, "What was I actually trying to do here?" So for example, "Update all the rigs in the mocap RAW file to the latest version of the rig", that would be a high level goal that I was trying to do, but maybe that takes like 30 clicks to do that.

Totals	Total Times	% of Total Time	Ease of Automation
Junk Tasks	00:06:56	9.83%	Unnecessary
Find and open correct mocap file in mocap delivery directory	00:02:13	3.14%	Very Hard
Update rigs in the mocap file to latest/assetized rigs	00:04:47	6.78%	Easy
Transfer animation data to new rigs in a clean file	00:02:22	3.36%	Easy
Fix viewport performance issue	00:01:28	2.08%	May be unnecessary
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Setup Export Nodes and Export animations	00:02:22	3.36%	Easy
Dampen hand and finger motion	00:03:43	5.27%	Easy
TOTAL	01:10:30		

- And then I totaled up the times for each of these goals.

Totals	Total Times	% of Total Time	Ease of Automation
Junk Tasks	00:06:56	9.83%	Unnecessary
Find and open correct mocap file in mocap delivery directory	00:02:13	3.14%	Very Hard
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Fix viewport performance issue	00:01:28	2.08%	May be unnecessary
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Process mocap from one long take to short animation clips	00:05:58	8.46%	Easy
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Setup Export Nodes and Export animations	00:02:22	3.36%	Easy
Dampen hand and finger motion	00:03:43	5.27%	Easy
TOTAL	01:10:30		

- And then I estimate how difficult this task would be to automate.
- And this estimation is partly based on my knowledge of Motionbuilder and of what I know is possible, but also based on how much I'm actually thinking about what I'm doing when I'm doing this task, and how much I'm just going through the motions. If I have to make creative decisions or if I need to start using a lot of core animation principles, then it's immediately classified as a task that would be either hard or impossible to automate.
- But... as you can see with all the green on the right here... you'd be surprised at how many of these tasks only require really basic information to make decisions, information like "what pose should I be pasting here" or like, "what 's the exact direction do we supposed to be turning to", that kind of thing.

How inefficient are we?

- So... exactly how inefficient are we?

How inefficient are we?

- **53.76%** of time = Easy to automate

- ...about 54% of the time animators are spending cleaning up mocap, is on tasks that are Easy to automate.

How inefficient are we?

- **53.76%** of time = Easy to automate
- **25.58%** of time = Medium difficulty to automate

- ...another 25% of animator time is on tasks that are medium difficulty to automate.

How inefficient are we?

- **53.76%** of time = Easy to automate
- **25.58%** of time = Medium difficulty to automate
- **20.66%** of time = Hard or Impossible to automate

- ...and only about 20% of animator time is on tasks that would be hard or impossible to automate.
- I just want to drive this home...

50 – 80%

- 50 – 80 percent... of the time that your animators are spending cleaning up mocap... is time that a computer could probably be doing that work!
- So... admittedly, these are very rough numbers. There are a lot of variables at play here and if you did the same analysis on your own pipeline you'd probably get something different, but... in my experience what we do with mocap at Ubi is pretty much comparable to what other studios do, and... you know... some of you might not even be that surprised at this when you think of the kinds of tasks that you do with mocap clean-up.
- So armed with this...kind of crazy statistic... we started to look at how we might go about automating these tasks...

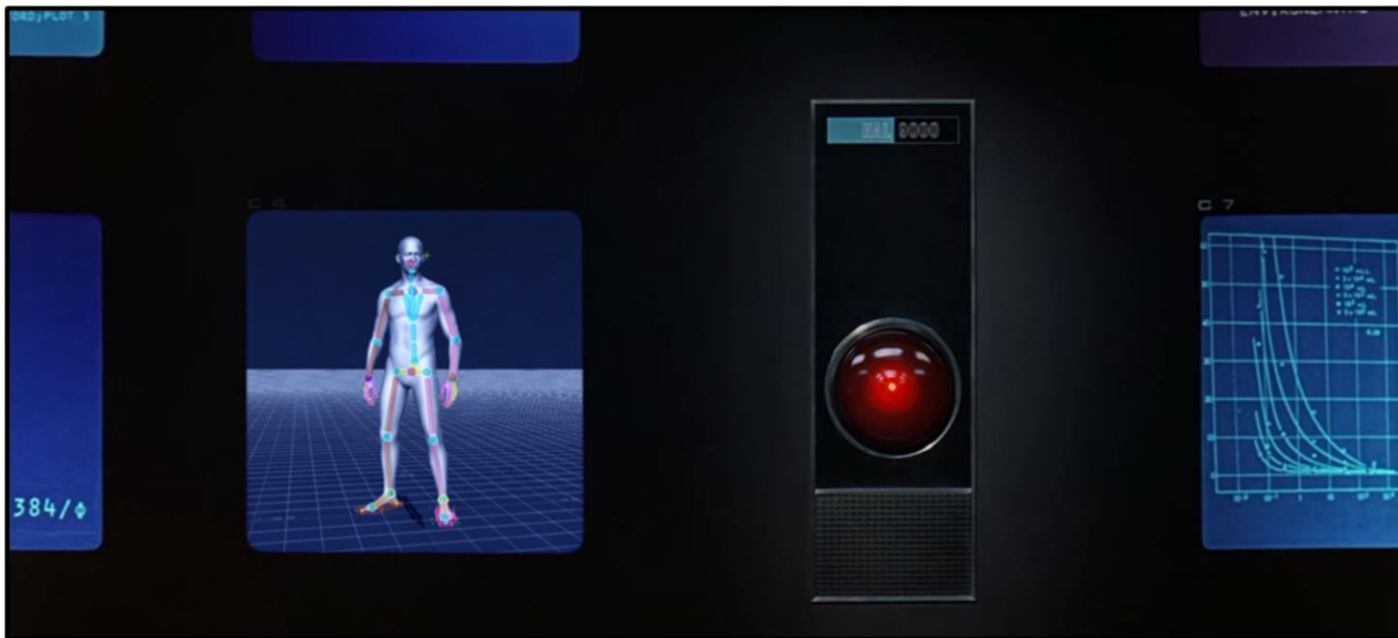
Find and open correct mocap file in mocap delivery directory
Update rigs in the mocap file to latest/assetized rigs
Transfer animation data to new rigs in a clean file
Fix viewport performance issue
Scene/File/Application Clean-up
Select clip ranges
Process mocap from one long take to short animation clips
Animate the displacement to match character movement
Build a weapon heirarchy for better interpolation during edits
Merge and update poses from Pose Bank
Apply key poses
Fix glitches in pose adjustment
Center the character in the scene
Setup Export Nodes and Export animations
Dampen hand and finger motion



```
Python Editor
Python 2.7.9 (default, May 9 2015, 00:03:40) [AMD64] on win32
File

1 # This tool uses the necessity of a motion capture rig to modify the bones of a pose layer.
2
3 # Essentially, the rig allows animators to set poses and not worry in its movement layer, and instead
4 # simply just placement and animation weights.
5
6 # The idea for this tool was created by Daniel Linn (daniel.linn@blizzard.com)
7
8 # This module has no explicit dependencies, but uses the "Pymath" module from Blender.
9 # Replacing the Blender module with a custom module would remove these dependencies.
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11 # Author: 2015-05-15
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- Now with me saying all that...this is probably a good time to stress... the goal here is not to *replace* animators.
- It would be extremely difficult to teach a computer how to correctly apply animation principles.
- The real goal here is to reduce the amount of time that animators have to spend on these kind of...boring processing tasks... so that we can focus more on the creative decisions... which is the fun stuff!
- So I don't think anyone shouldn't be afraid of automation, it's not going to get rid of animators, it's just going to help us do more things... faster.
- So here is how the Automator works...



- This is stuff is kind of difficult to comment on live because I move around the UI pretty fast, so I pre-commented a video and I'm just going to let it run.
- [Long video showing me demoing the Automator tool. I take one long take of mocap which contains multiple turn on spot motions to different angles, then for each angle, I add annotation information in the Automator, that describes the frame range that I want to clip out. Then I set options for how I want each of these frame ranges to be processed: Turning to exact angles rather than the rough mocap angles, clamping the hands to the gun, specifying start and end poses to be applied, and so on. When I'm done I hit the "Animate" button, and it processes the data. What I end up with is clean processed files that can be worked on top of, or exported directly into the game].
- So... this is where we are right now with automation... but if we keep going down this path, what does the future look like...



- [Short clip of the robot apocalypse from Terminator 2]
- ... OK... I'm just kidding...



- Really ...with automation, the sky's the limit.
- The more that you work on this stuff, the more you start seeing opportunities to automate more things.
- After doing this it's actually kind of hard for me to go back to regular animation because every time I do anything I start thinking about how I could write a script to automate it.
- For us, our immediate future is supporting as many use cases and edge cases, as possible.
- I also want to start looking at automating tasks for motion matching pipelines... if you're not familiar with motion matching you should really stick around for the next talk cause Kristjan is gonna show some pretty amazing stuff.
- We're also thinking about how we can automate animation integration into the game engine using the same annotation data that we add to the Automator.
- Finally, I'm also really excited to see how well adjustment blending works out at runtime, and I do really hope that some of you guys try that method out at your own studios, and maybe see how you can evolve it yourselves.



- And thanks for taking the time to be here.
- Questions?